Pontifícia Universidade Católica
do Rio de Janeiro

Rafael de Carvalho Cayres Pinto

Three essays on labor market institutions and labor turnover in Brazil

Tese de Doutorado

Thesis presented to the Postgraduate Program in Economics of the Departamento de Economia, PUC–Rio as partial fulfillment of the requirements for the degree of Doutor em Economia

Advisor : Prof. Gustavo Maurício Gonzaga
Co–Advisor: Prof. Juliano Junqueira Assunção

Rio de Janeiro
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Abstract

Pinto, Rafael de Carvalho Cayres; Gonzaga, Gustavo Maurício (Advisor); Assunção, Juliano Junqueira (Co-Advisor). **Three essays on labor market institutions and labor turnover in Brazil**. Rio de Janeiro, 2015. 89p. PhD Thesis — Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

This thesis consists of three papers about labor market institutions and labor turnover. The first paper deals with the effects of enforcement of labor laws on turnover among formal workers. Examining data from RAIS, the paper discusses a previously undocumented discontinuous reduction in the layoffs at one year tenure. The analysis suggest that this results from the requirement of homologation for termination of those contracts, which works as a firing cost. Firms subject to low inspection frequency respond to stricter enforcement by increasing turnover during the first year, thus avoiding the payment of evaded benefits. The second paper analyses two distortions potentially present in Brazilian labor market institutions: collusion between workers and firms to withdraw funds from unemployment insurance and FGTS, and the incentive for termination of employment contracts before one year, to avoid the homologation. The effect of these distortions on firms' turnover strategy is quantified by a model. The results indicate that both distortions have effects on the distribution of layoffs over the employment duration, but little effect on the overall turnover, productivity and efficiency. The conclusion is that the distortions are relatively unimportant when compared to the selection of suitable employees for the job positions as a driver for turnover rates. In the third and last paper, we assess the impact of these distortions on the turnover and productivity through their influence on incentives for investment in labor relationships. A new model is proposed, in which labor productivity depends on investment in human capital by the worker. The model shows that distortions leading to high turnover decrease the investment in labor relationships. The lower investment, in turn, reduces relationships' values, inducing more turnover. Thus, the existence of rents associated with turnover can reduce investment in human capital and labor productivity.

Keywords

Unemployment Insurance; Labor Law; Labor Turnover; Human Capital; Brazil.

Resumo

Pinto, Rafael de Carvalho Cayres; Gonzaga, Gustavo Maurício (Orientador); Assunção, Juliano Junqueira (Co-Orientador). **Três ensaios sobre instituições do mercado de trabalho e rotatividade no Brasil**. Rio de Janeiro, 2015. 89p. Tese de Doutorado — Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Esta tese é composta por três artigos sobre instituições do mercado de trabalho e rotatividade da mão-de-obra. O primeiro artigo aborda os efeitos o monitoramento das leis trabalhistas sobre a rotatividade dos trabalhadores formais. A partir dos dados da RAIS, o artigo documenta de forma inédita, uma redução descontínua das demissões quando os contratos completam um ano. A análise sugere que isto se deve à exigência de homologação para a rescisão desses contratos, que funciona como um custo de demissão. Firmas pouco sujeitas a inspeções pelo MTE respondem a aumentos da fiscalização com mais rotatividade durante o primeiro ano, evitando o pagamento de dívidas trabalhistas. O segundo artigo analisa duas possíveis distorções presentes nas instituições do mercado de trabalho no Brasil: o conluio entre trabalhador e firma para a apropriação do seguro desemprego e do FGTS; e o término dos contratos de trabalho antes de completarem um ano, visando evitar a homologação. O efeito dessas distorções sobre as decisões de demissão é quantificado através de um modelo. Os resultados indicam que as distorções têm efeitos sobre a distribuição das demissões ao longo da duração do emprego, mas com pequeno impacto sobre rotatividade total, produtividade e eficiência. Conclui-se que a principal motivação para a rotatividade é a seleção de trabalhadores adequados. No terceiro artigo, procura-se identificar os efeitos das mesmas distorções sobre os incentivos ao investimento nas relações de trabalho. Elabora-se um novo modelo em que a produtividade depende de investimento em capital humano pelo trabalhador. O modelo evidencia que distorções que induzem à rotatividade diminuem o investimento nos vínculos de emprego. O menor investimento, por sua vez, reduz o valor da relação, induzindo mais rotatividade. Assim, a existência de rendas associadas à rotatividade pode resultar em baixos investimentos em capital humano e produtividade.

Palavras–chave

Seguro Desemprego; Legislação Trabalhista; Rotatividade; Capital Humano; Brasil.

Contents

List of Figures

List of Tables

1
Imperfect enforcement of employment regulations and turnover in Brazil

1.1
Introduction

In this chapter, we document the effect of the design and performance of monitoring and enforcement of labor regulations in Brazil on formal workers' turnover. More specifically, we consider the interaction between the low compliance with labor regulations and a legal procedure called homologation, which is an examination by Labor Ministry of job terminations required for tenures longer than one year. Combined, these features induce firms to terminate early some employment relationships, since allowing them to reach one year would result in eventually having to pay for evaded benefits.

We begin by describing legal provisions on firing and the system of enforcement of labor regulations. One important feature of the firing procedure is mandatory homologation of terminations occurring at tenures longer than one year. This procedure entails investigation of compliance with labor regulations during the entire relationship, such as contribution to Fundo de Garantia por Tempo de Serviço (FGTS), the workers' severance payment account. Further, homologation is shown to be hard to avoid, as it is required in order to the dismissed workers to receive unemployment benefits and access their FGTS balance. Thus it is likely that firing employees with over one year at the job is costly for non-compliant employers.

Next, analysis of RAIS data shows that, besides concentration at the beginning of employment relationship, separation hazard rates exhibit a substantial discontinuous drop at one year tenure. This discontinuity is driven by a 25% decrease in dismissals without cause by employer initiative, not appearing for other separation types (quits, firing with just cause, retirement). This previously undocumented feature of turnover in Brazil indicates that firms face a raise in firing costs when the labor relationship reaches one year. Using a data set of inspection activity provided by Labor Ministry's Inspection Secretary (SIT), we observe that firing patterns also varies with local enforcement level. Given firm size, the discontinuity at one year appears to be more pronounced among firms located on municipalities with higher inspection activity.

This relationship between inspection intensity and the discontinuity is confirmed by estimation of an empirical model of firing hazard that allows for different effects of inspection intensity before and after one year. A rich set of controls representing quality of institutions and integration to markets is used to isolate the effects of labor regulation enforcement. Further, we deal with potential endogeneity of inspection. Following Almeida and Carneiro (2005, 2009, 2012), we use data on distance from each municipality and the closest Labor Ministry's inspection office (DRT) as an instrument for inspection intensity. Results show that first year firing hazard increases and discontinuity widens along with increased inspection intensity for firms with less than 100 employees. Further, frequency of inspections also increase firing hazards faced by the workers of these firms at higher tenures.

Our findings suggest that this turnover behavior is generated by two effects. First, in a context of noncompliance with workers' benefits, mandatory homologation acts as an effective firing cost introduced at one year tenure. Intuitively, the turnover behavior generated this way is consistent with observed heterogeneity in patterns across firm size. Large firms are frequently visited by labor inspectors and thus should not have much liabilities related to unpaid benefits and in this case homologation has no effect in firing decision. Second, occurrence of inspection corresponds to a raise in labor costs for the firm, in the sense of enforcing employees' benefits. Therefore value of long term employment relationships for non-compliant firms is decreasing in inspection frequency, which thus induce more separations, specially in early periods.

The paper is organized as follows. In the next section, we make a brief review of the related literature. Section 1.3 presents the institutional background. In Section 1.4 we describe the data sources we use for the empirical analysis. Next, we proceed our analysis of separation by tenure across different firms, workers and enforcement environments in section 1.5, and discuss how these patterns may be associated with Brazilian institutional setting. Section 1.6 concludes.

1.2
Related literature

The interest in the effect of enforcement of labor regulations on turnover originated from the need to circumvent a criticism to the first assessments of the effects of employment protection legislation (EPL). Most of the early analyses of EPL effects, performed through the 1980's and 1990's, have relied on cross-country comparisons and changes in legislation. However, labor market institutions are highly correlated with other social (such as legal systems, culture) and economic characteristics (taxes, product market regulation, macroeconomic shocks) thus making difficult to separate of the effects of each factor (see, for an example of this discussion, Freeman (2007)).

Thus, more recent studies of EPL effects begun to focus on heterogeneous incidence of labor market institutions across units. Autor et al. (2006, 2007), for instance, explored the variation in timing of adoption by state courts of restrictions to employer's ability to dismiss workers without justification in the United States. Boeri and Jimeno (2005) use a double-difference approach, comparing dismissal probabilities of temporary and permanent workers in Italian firms of different sizes. EPL applies to all workers with permanent contracts, but the most restrictive provisions are not enforced in firms with 15 or less employees. Marginal effect of permanent contracts on separation rate is negative and its magnitude abruptly increases at the 15 employees threshold, indicating that stricter EPL leads to important reductions in worker flows.

The relationship between tenure dependent firing costs and the firing hazard function, which we explore here was first applied by Marinescu (2009), in her analysis of the reduction in minimum tenure required for the worker to sue the employer for unfair dismissal, from two to one year, in UK. She compares responses of separation hazard for workers of three tenure groups – 1-11, 12-23 and 24-48 months – to the change in legislation. Firing hazard of workers directly affected by the policy change (those with tenures between one and two year) decreased by 26% when compared with those of "control group" (more than two year). Although not targeted by the change, workers with tenures shorter than one year also had reduced firing hazards. Marinescu (2009) concludes that this evidence suggests firms respond to the policy by improving recruitment, generating better quality matches and thus reducing separation. This is the only study we are aware of that directly evaluates effects of tenure dependent EPL on the distribution of separations across job duration.

Closer to the empirical methodology used later in this chapter, some recent studies exploit geographic variation in enforcement of a same legislation. Fraisse et al. (2009) look at heterogeneity of labor court inputs across local jurisdictions to assess the effects of labor disputes' outcomes on job flows. They use local-level data such as the number of registered lawyers, judges/cases ratios, and labor courts' staff as instruments for the probability of a dismissed worker filing a case against the firm, and for the ratio of cases ending in each possible outcome (the case being dropped by the court, a settlement being made before the trial, the trial being won by each party). Their main findings are that dropped cases and cases reaching the trial stage (i.e., failure to achieve a settlement) represent lower protection, being associated with more separations; whereas filing rate and settlements are associated with higher firing costs and reduced job-destruction.

Besides the courts, enforcement of employment regulations typically rely on inspections conducted by government officials. These, also have potentially high degrees of geographic heterogeneity, specially in large developing countries such as Argentina (Ronconi, 2010), Brazil (Almeida and Carneiro, 2005) and Russia (Gimpelson et al., 2010). Gimpelson et al. (2010) exploit heterogeneity in both labor inspection and judicial system. They use a panel of eighty regions and six years (2000-2005) and exogenous (number of inspectors and judges) and potentially endogenous (inspection missions, violations found, cases filed) measures of enforcement. Their results show that the number of inspectors and cases filed in labor courts have negative effect on employment and positive effect on unemployment, specially among female and young workers. Comparing enforcement provided by inspection and courts, they find that the former have greater effects.

In our main empirical exercise, we explore the same variation as Almeida and Carneiro (2005, 2009, 2012), namely, that of distance between the city in which a firm is located and the closest city with an inspection office. Controlling for factors like the quality of other institutions and integration to external markets, this variable captures the effect of inspection intensity. With this approach, Almeida and Carneiro (2005) have found that enforcement reduces employment of informal workers and decrease wages, productivity and investment. The wage reduction effect, in turn, is shown to be associated with compliance with regulations which are valued by the workers (Almeida and Carneiro, 2009). Closer to our focus, Abras et al. (2014) investigate the relationship between enforcement of labor regulations and job flows. They find that between 1996 and 2006, an increase in enforcement was associated to higher formal job creation and reallocation, while the effect on job destruction was not statistically significant.

Our analysis also add to the body of literature on the Brazilian labor market institutions that points out that the functioning of these institutions, notably the FGTS, may actually subsidize turnover, as pointed out by Amadeo and Camargo (1996); Gonzaga (1998); Barros et al. (2000); Gonzaga (2003), and further discussed in the next section. The analysis in this paper proposes another mechanism through which the Brazilian institutions may induce excessive separation. Our findings indicate that turnover at the first year may be intensified by an institutional setting that generates an increase in effective firing costs after the employment contract completes one year.

1.3 Institutional background

In order to understand the pattern of employment turnover in Brazil, we begin by describing the institutions that affect the decision to terminate job contracts. These basically comprise rulings restricting firing by the firms and the benefits the worker may receive when fired. We also discuss enforcement of labor regulations, which, as we will see, plays an important part in shaping the environment economic agents effectively face.

In Brazil, formal employment relationships are ruled by labor legislation, mainly the labor code – or CLT (Consolidação das Leis do Trabalho) – and the Constitution, which provide a minimum standard for labor conditions. The CLT established regulations over working time, benefits and workplace safety. These were greatly expanded by the 1988 Constitution (see, e.g., Gonzaga, 2003). Most of labor contracts – approximately 80% of the total and 95%, if public administration is excluded[1]– are open-ended CLT, requiring compliance with legal termination procedures and compensations for the workers dismissed without just cause.

1.3.1 Separation procedures and legal firing costs

In practice, firms can avoid firing costs for the first three months of the employment relationship. The legislation allows the firm to propose an experience contract of up to 90 days. At the end of this contract the firm can dismiss the employee without cost, or convert it into a CLT open-ended one, incorporating the current tenure. If the initial contract is shorter than 45 days, it may also be extended once for a period of equal length. Thus, for up to three months, employer faces no constraints to firing besides the constraint on divisibility of the experience contract.

When a firm intends to terminate an open-ended CLT contract, it must give the worker advance notice of dismissal. Until 2011, all workers were granted a one month advance notice period; more recently this period has received an extension, proportional to dismissed worker's tenure. After the notice, the firm may either keep the worker at the job, with 25% reduction in daily or weekly working time, or pay the corresponding wages and dismiss the worker immediately. Further, CLT requires the firm to settle all payments

[1]Civil servants' labor contracts are defined by a different law.

(due wages, benefits and dismissal compensation) one day after last worked day, in the former case, or then days after notification, in the latter.

For dismissal without cause, the firm must pay the worker a fine. Since 1988, this compensation corresponds to 40% of the amount it contributed to dismissed worker's severance fund (FGTS, discussed below). In 2001 this cost was raised to 50%, with the additional 10% being paid to the government.

Employment stability rules apply to workers returning from sick leave caused by workplace accident, those which are pregnant or gave birth in the last five months, and elected union representatives. Stable employees can only be dismissed with just cause.

Finally, termination of an employment relationship that lasted at least 12 months must be overseen by the employee's union or a Ministry of Labor's official. This supervision, which is called assistance or homologation, aims to explain workers' rights and enforce compliance with them. The procedure, even when performed by the union, is subject to regulation issued by Labor Ministry, concerning issues such as parts' representation, the required documentation and observation of employment stability rules.

1.3.2
FGTS system and unemployment insurance

Employers contribute monthly to their workers' FGTS (Fundo de Garantia por Tempo de Serviço) accounts with 8% of the wage. Since 2001, firms started to pay an additional of 0.5% of the monthly wage to recover fund's losses with legal disputes over adjustment indexes after monetary stabilization episodes in 1989 and 1990[2]. The fund's balance is available to the worker when he is dismissed (but not when he quits), and thus employer's contribution can be viewed as a provision for severance payment. Indeed, as shown in Gonzaga (2003), the system was designed to approximately match the severance payments in effect under the previous institutional setting.

Besides the access to FGTS balance, workers dismissed after at least six months in the job are eligible to unemployment insurance. Monthly benefits' value is calculated as a function of earnings at the lost job. They are bounded from below by the minimum wage and from above by 1.8 minimum wages, and have marginal replacement rate ranging between 50% and 80%. Benefit is paid for three months, if the worker was employed for six to eleven months in the last three years; four, if employed for 12 to 23 months in the same period; and five, if employed for 24 to 36 months.

[2]This effort resulted also in the additional 10% fine for dismissal mentioned earlier. Both additions are paid to the FGTS, not to workers' accounts.

1.3.3 Compliance and enforcement of labor laws

Violation of labor regulations is widespread. Besides a significant informal labor market, noncompliance with formal workers' rights is also a concern. In the last years, more than 300 thousand (out of the 3 million) firms were found to have failed to contribute to their workers' FGTS accounts. Every year firms' debts with FGTS have grown by R$ 1 billion, and have reached R$ 17.5 billion in 2011, when fund's assets amounted to R$ 290 billion.

Another evidence of low compliance is the high litigation rate (see, e.g. Camargo (2006)). Since the 1990's, 1.5 to 2 million cases are taken to labor courts every year, almost exclusively after contract termination [3]. As roughly 10 millions labor contracts are terminated annually, this suggests that at least 15% to 20% of the formal employment relationships did not fully abide to the law. As litigation is costly, and thus some irregularities are not taken to the courts, this number may underestimate the true extent of noncompliance with labor regulations.

Camargo (2006) points that labor courts functioning itself provides incentive for noncompliance by employers. Definitive sentences may take as long as four years, inducing the worker to settle the case early at conciliation stage. Generally there are no effective penalties for violating labor regulation, as the worst result for the firm is to pay the amount demanded by the worker.

Labor inspection

Labor inspection is the Labor Ministry's primary instrument to enforce regulations. This activity is performed by civil servants, the labor inspectors or AFTs (Auditor Fiscal do Trabalho). Inspections comprise visits to establishments, which must present its employment records [4] and answer to inquiries by the AFT. When violations of labor laws are detected, a notice of infraction is issued, which may result in imposition of fines, after the firm presenting its defense and the case being examined by a different AFT. Later, follow-up inspections are made in order to verify whether the firm adjusted its labor policy.

Since the 1990's, the efforts to attain fiscal and monetary stabilization shaped labor inspection activities. Fiscal effort increased concern with collection of FGTS contributions, as they are considered a tax revenue (Almeida and Carneiro, 2012). Further, losses related to inflation stabilization

[3] Cardoso and Lage (2007) point that more than 90% of them included complaints over dismissal compensation.

[4] CLT establishes mandatory documentation the firms must keep for inspection.

plans and increasing evasion threatened the FGTS system. Besides that, as inflation was controlled, fines became an effective punishment, increasing the importance of inspection as a mean of enforcing labor laws (Cardoso and Lage, 2007). Labor inspection emerged from this period as an important activity for the government, and became narrowly associated with the defense of FGTS system.

The design and performance of inspection confirms this focus. Until recently, inspectors had considerable performance pay incentives, corresponding to 60% of their wage, related to FGTS collection. After 2009, this incentive ceased to exist, but FGTS remained as a central point in Ministry of Labor planning and internal performance evaluation, and large amounts of contributions continue to be charged as result of inspection activity. Since the 1990s, at least 3% of FGTS collection is made by inspection activity. Another reflex is the use of RAIS data in the definition of inspection strategy, thus biasing the efforts toward the formal sector (Cardoso and Lage, 2007; Almeida and Carneiro, 2009).

Another important aspect pointed by Cardoso and Lage (2007) is the high "rate of regularization", which is measured as the proportion of firms which adequate themselves to labor regulation as a response to AFTs' demands. This statistic is measured annually by Labor Ministry and usually ranges from 75% to 85%.

As a result of the targets chosen by the Ministry of Labor and the incentives it provides to AFTs, inspection deals mainly with large, formal firms.

A last point that also deserves attention is geographic heterogeneity of inspection. Inspection activity is planned at by state-level jurisdictions called Superintendências Regionais do Trabalho e Emprego (SRTE). The execution of this activity is carried out at the level of Delegacia Regional do Trabalho e Emprego (DRTE), an infra-state jurisdiction. Location of DRTEs and staffing decisions naturally lag behind economic development of local labor market, resulting in different levels of enforcement. This variation was first documented by (Almeida and Carneiro, 2009), which shown that distance in hours by car to nearest DRTE is a determinant of inspection intensity across cities.

Homologation as a monitoring device

Although created as a mechanism to ensure compliance with dismissal regulations, homologation also results in examination of other aspects of the employment relationship.

Besides firing compensation, the firm must pay any remaining obligations it have with the worker (delayed wages, overtime compensation, etc.) at the meeting or before it takes place. Payments must be made in money or check at the meeting, or proved to be already transferred to worker's current account. Further, the firm is required to show receipts of the FGTS contributions made throughout the relationship, and present an account of worked overtime hours.

Disagreements over values are simply written in the deed of termination and have no immediate consequence (the worker can later take those to labor courts). However, if the firm fails to pay undisputed obligations, it receives a fine corresponding to the last monthly wage (to be paid to the worker) plus a fixed amount (currently R$ 251.20, paid to the government). Further, if assistance was provided by Labor Ministry, this event is immediately reported to the inspection department. Some unions also have specific policy written in collective conventions, which may include additional fines.

The fine for uncontroversial obligations is substantial. For instance, after one year failing to contribute to employee's FGTS account, the employer would have accumulated approximately one monthly wage in debts. Therefore it is cheaper to make all the delayed contributions than to pay the fine, which would exceed this amount in R$ 251.20 and would not cease his debt.

Importantly, homologation is required when a worker (dismissed from an employment which lasted more than 12 months) withdraws from his FGTS account and/or applies for unemployment insurance. This makes assistance hard to avoid, as this would be costly for the worker, which thus has strong incentive to demand it. Thus, homologation should be effective in enforcing payment of benefits such as FGTS contributions, at least for workers with tenure just over one year.

Another relevant point is that, differently from inspections, homologation is likely to apply homogeneously to firms of different sizes and locations. There is, on one hand, a strong pressure from the worker to require that homologation take place. On the other, as we have pointed early, the procedure itself is centrally regulated.

1.4 Data

1.4.1 Duration data, firms and workers' characteristics.

We use data from Relação Anual de Informações Sociais (RAIS) for the years 1995 to 2010. This is an administrative database, sent annually by firms to Labor Ministry and covering employment contracts that were active for at least part of the previous calendar year. Virtually all formal employment relationships in Brazil are covered, amounting to over 40 million observations in the recent years.

Each record represent a single employment contract and include information such as the hiring time, type of contract (open-ended CLT, temporary CLT, public employment, apprenticeship, etc.), whether/when it was terminated during the year and type of separation. Since 2003, data include exact hiring and separation dates, allowing for exact calculation of job relationships' duration.

Firms are identified by their corporate identity numbers, allowing to determine their size (number of active employees) at any given time. Firm type and sector is also available. In 2006, CNAE 2.0 was introduced as the standard classification of economic activity, defining more than 1300 sectors, organized in a 5 level hierarchy. For our empirical exercise, we use size of the firms at the beginning of each year, obtained by looking at firms' size at the end of the previous year. We count the number of different employees working for the same employer and classify the firms in ten categories [5] (such variable, with the same 10 categories is readily available in RAIS, but contains many errors), plus a separate code for new firms (those not appearing in previous year). For sector, we consider the "Division" level, corresponding to the first 2 digits of CNAE and comprising 87 categories.

For the workers, there is information on gender, age, educational level and, from 1998 on, race. It is also possible to link the records for the same worker, as an identity number is provided.

1.4.2
Inspection data

Ministry of Labor provided, for years 2006 to 2011, the number of inspections, workers reached and violations caught in the year among firms of each sector/municipality pair. Firms' sector is reported using CNAE 2.0 classification (see RAIS description below). Violations are classified into ten groups, including registration of workers, working hours, wages, FGTS contributions, safety regulations and child labor. It is also possible to obtain from MTE's public data, since August 2008, the number of labor inspectors ("Auditores Fiscais do Trabalho", AFT) in activity in each state.

[5] 0, 1 to 4, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 500, 501 to 999 and 1000+ employees

1.4.3 Municipalities

We use the same data on economic and institutional development of municipalities employed by Almeida and Carneiro (2012), including their data on distance to closest municipality with a DRT.

Importantly, we use a set of controls for the quality of institutions. Two of them were developed by Naritomi (2007): a political concentration index, defined as the Herfindahl index of parties' shares of votes in the election for the city council; and an index of access to justice, calculated as the sum of the indicators of presence of Small Causes court, "Conselho Tutelar"[6] and Consumer Protection Commission. The third institutional control is the index of governance from Pesquisa de Informações Básicas Municipais (IBGE, 2001), which measures cities' administrative capabilities according to the presence of management instruments. These variables are available as of year 2000.

Proxies for integration to other markets are also available. We use IBGE's index of transportation costs and distance (in hours by car) to the nearest state capital. Finally, our municipality controls include GDP and population at 1970, 1980 and 1991 Census, and latitude, longitude, altitude and area.

1.5 Analysis of separation and firing hazard

1.5.1 Separation and firing hazards

In Figure 1.1 we use RAIS data to obtain aggregate separation hazard function[7] for selected years.[8]

The graph shows that turnover is particularly high among low tenure workers. Indeed, in the considered period, more than one half of the contracts was terminated before completing one year. Qualitatively this is consistent to findings dating back to Mincer and Jovanovic (1981) of negative structural relation between tenure and probability of termination. This relation can be explained by ex-post revelation of match productivity: as information of match

[6]A public, independent agency in charge of protection of children rights.

[7]The hazard function regarding a given event is defined as the probability of occurrence of the event at each time, given that it has not occurred before. In this case, it is the probability of a job relationship, that reached a given tenure, being terminated at that moment.

[8]We discretize tenure as follows: tenure variable t equals m if the contract lasted for m months plus one to fifteen days; t equals $m + 0.5$ if lasted m months plus sixteen or more days or exactly $m + 1$ months. This discretization was chosen in order to produce bins of equivalent length while allowing to distinguish labor contracts subject to mandatory homologation, the main institution for our purposes. On the other hand, for unemployment insurance purposes, fifteen days are equivalent to one month.

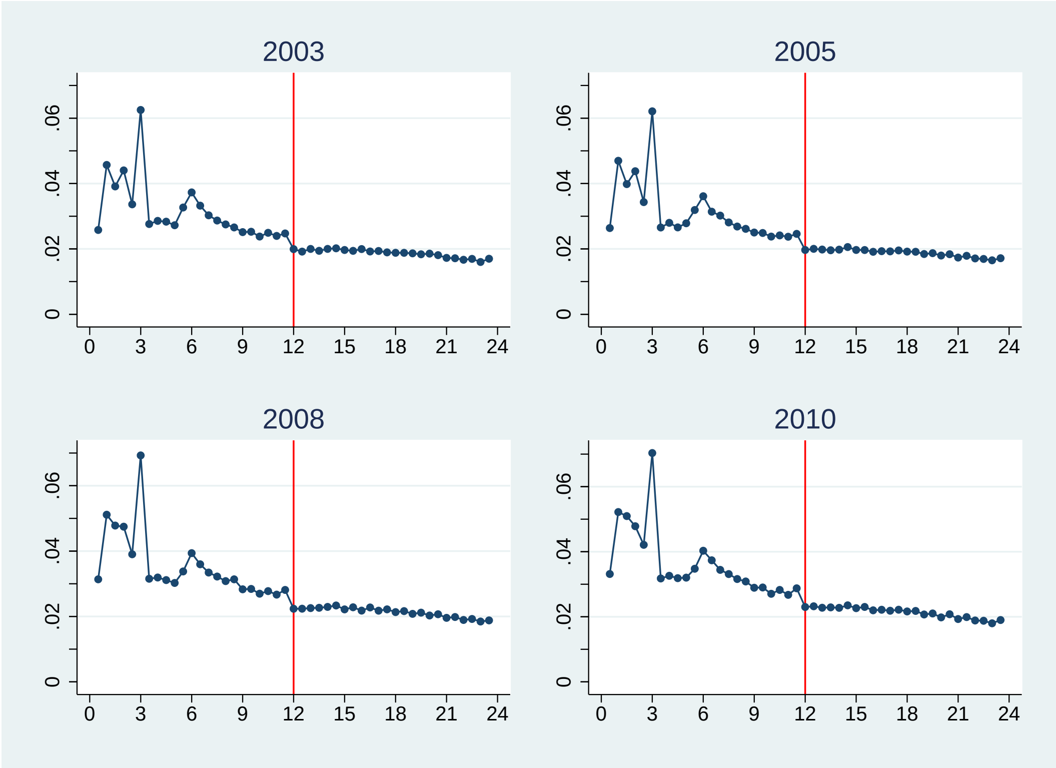


Figure 1.1: Aggregate firing hazard. Source: Elaborated by the authors from RAIS data (2003 to 2010).

productivity is obtained bad matches are dissolved; as employment duration increases, most of remaining matches have high productivity, and thus hazard eventually falls. This pattern is also consistent with increasing firing costs.

Further, it can be noted that the shapes of those hazard functions are very similar across years, and always exhibit the same patterns around three, six and twelve months. Hazard rates, which are increasing just before three months, drop discontinuously immediately after that point. At six months a similar effect takes place in the opposite direction, with hazard exhibiting a discontinuous positive jump. Finally, at twelve months, once more hazard increases and then discontinuously drops.

The effect at three months clearly reflects the timing of introduction of firing costs (as we have discussed above), which become effective as labor relationship reaches 90 days. Firms seek to anticipate dismissals before they become costly. Behavior of hazard close to six months is associated with eligibility for unemployment insurance: a firm can delay a dismissal in order to let worker be eligible, either because of rent sharing or fairness considerations.

The discontinuity at twelve months, in turn, cannot be associated with the legal values of job security provisions. Severance payments, unemployment insurance benefits and the fine for dismissal without just cause do not change discontinuously at that point. However legal procedures do change. For contracts longer than one year, firm must present documentation regarding the employment relationship to Labor Ministry or dismissed worker's union at a mandatory homologation meeting.

Figure 1.2: Separation hazard by initiation and reason. Source: Elaborated by the authors.

Figure 1.2 decomposes separation hazard according to which part initiated the separation and the reason (whether the worker was fired with just cause or not, quit, and other reasons). We analyze data from 2010; effects observed are qualitatively identical and similar in magnitude for other years. This decomposition shows that discontinuity in termination data at twelve months is driven by the 25% drop in firing without just cause hazard, while the other components remain continuous. This suggests that firms experiment higher costs when they terminate relationships that lasted for more than one year.

In Figure 1.3 we focus on firing hazard and disaggregate the establishments by size. We note that larger firms firing behavior is not discontinuous at twelve months. Together with our discussion of the potential effect of homologation, this may be interpreted as an evidence that firms consider mandatory homologation costly when they fail to comply with their employees' legal benefits. As large firms are subject to frequent inspections, they have large incentive to comply with regulations and thus little incentive

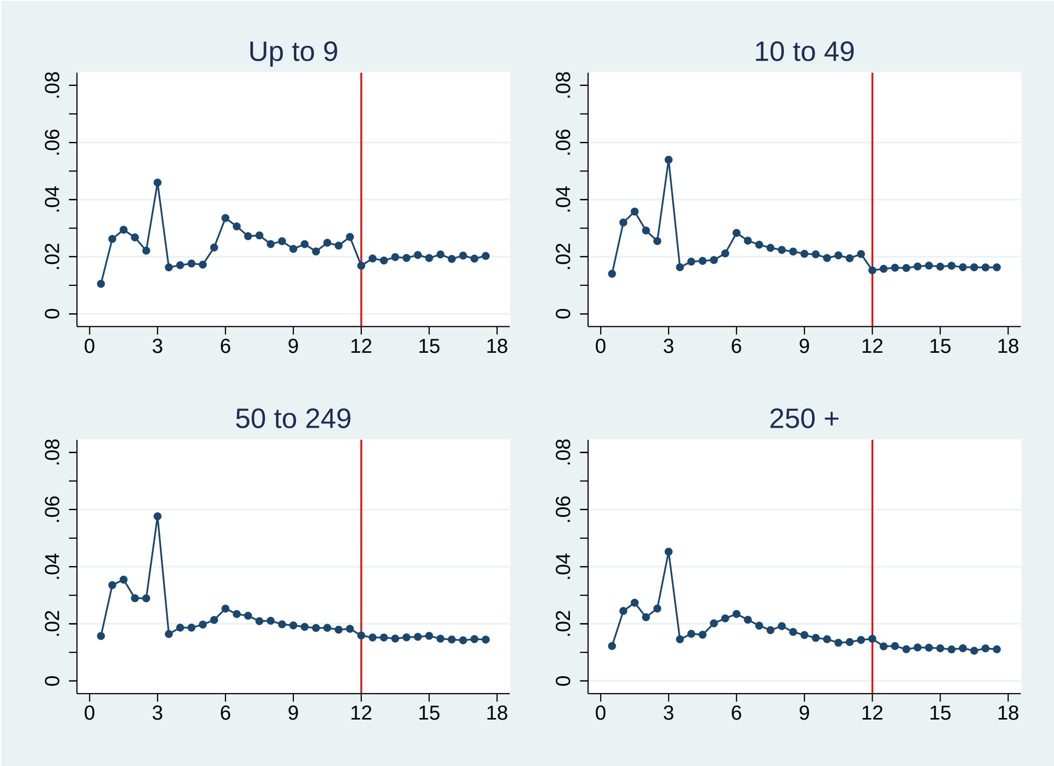


Figure 1.3: Firing hazard by firm size. Source: Elaborated by the authors from RAIS/2010.

to avoid homologation. In other words, this suggests that inspections and homologation work as substitutes.

There are other determinants of monitoring level besides establishment size. In order to assess the hypothesis just presented in a more direct way, we next use Labor Ministry's inspection department data to compare firing hazard across groups of firms located in municipalities with different inspections to firms ratios. The results are shown in Figures 1.4 and 1.5. We note that, across firms of the same size, inspection intensity appears to increase the gap at twelve months, the opposite of the relation one should expect according to the substitution effect we have just described. It is also worth noting that the change in the size of the discontinuity results mainly from a greater firing hazard at the first year exhibited by the firms facing more inspections.

Before proposing an explanation, in the next two subsections we further confirm evidences of Figures 1.1-1.5 by isolating effects of inspection from those of municipalities', firms' and workers' characteristics. Namely, we estimate a Cox proportional hazards model for firing hazard, allowing for non-proportionality of the hazards across firms with different inspection intensity. We examine how inspection intensity affects the shape of firing hazard, specially around one year tenure.

In order to deal with potential endogeneity of inspection, we control for

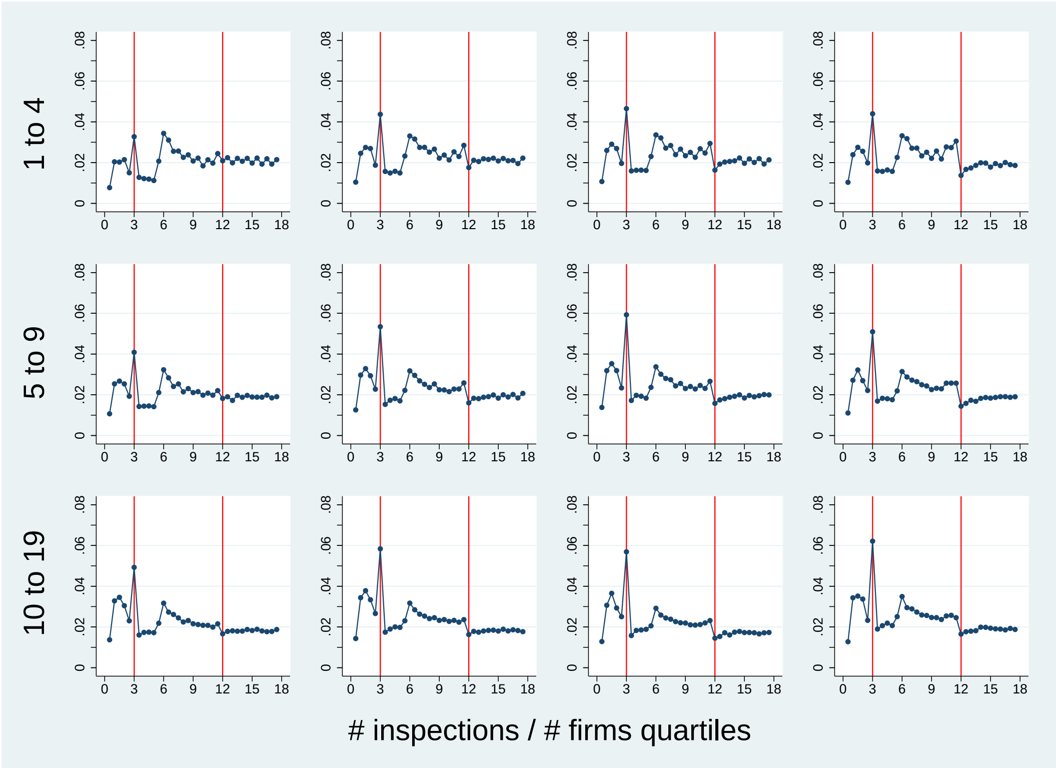


Figure 1.4: Firing hazard by firm size and inspection intensity (quartiles increasing from left to right), small firms.

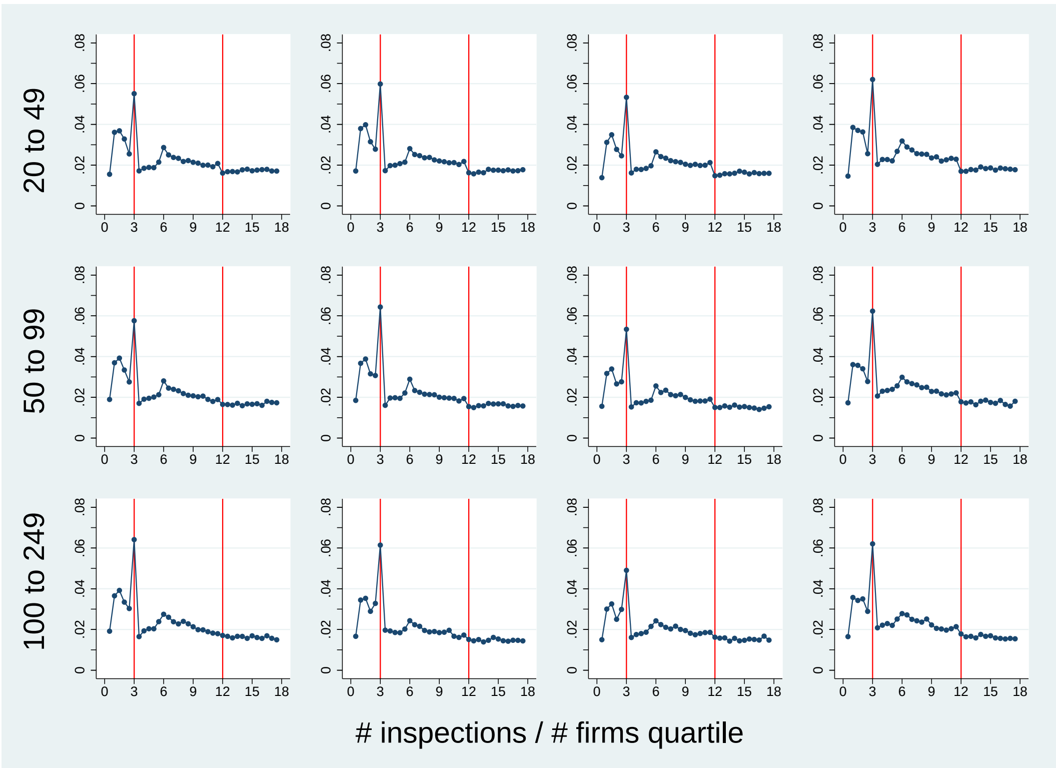


Figure 1.5: Firing hazard by firm size and inspection intensity (quartiles increasing from left to right), medium firms.

many variables reflecting quality of local institutions and integration to big markets. We also use distance from next inspection office as an instrument for inspection intensity. As already noted, this strategy was first used by Almeida and Carneiro (2009).

Almeida and Carneiro (2012) introduce another approach in order to control for a potentially endogenous choice of offices' location. In their data, states where there is relative abundance of inspectors have weaker relationship between distance and inspection intensity. They use this fact to evaluate enforcement by comparing the effect of distance on labor market outcomes across states with different relative inspector endowments. We do not follow this approach because, as will be shown shortly, our data presents no evidence of differential effect of distance, once we control for firm size distribution.

A distinctive feature of the present analysis is the treatment of heterogeneity of inspection effects across firm size. (Abras et al., 2014) address this heterogeneity indirectly, by comparing the effects of enforcement in cities with different average plant size. Their results suggest that enforcement increases turnover and net job creation in cities with smaller firms – those whose average plant employed less than nine workers –, while the effects are found to be statistically insignificant for cities with larger firms. In our analysis, we find separate estimates of the effect of inspection intensity on firing hazards.

1.5.2
Inspection intensity by firm size

As was discussed earlier, inspection intensity depends mainly on firm size and physical distance to local inspection offices, the DRTEs. We also noted that inspection focuses on formal firms, using RAIS data as a source of information for planning purposes. Finally, inspection activity is managed at the level of the SRTEs, which are state level offices. Almeida and Carneiro find that, in particular, distance effect is weaker in states with larger endowments of labor inspectors.

These facts suggest estimating the dependence of the proportion of inspected firms by municipality/sector cell on the distance to the closest municipality containing a DRTE, and the distribution of firm sizes among the firms in formal labor market.

We are interested in obtaining expected inspection frequency for a firm given its characteristics. Unfortunately, inspection data is aggregated by municipality/sector cells. We first model expected annual number of inspections in a firm of size s, belonging to cell $c = (m, a)$ (municipality, sector), under jurisdiction j by:

$$E[frqinsp_{s,c,j}] = g_j(s, dist(m), a)$$

where $dist(.)$ is the distance (in hours by car) to the closest municipality with an inspection office. The expected number of inspections per firm in cell c, is then given by:

$$E[frqinsp_{c,j}] = \sum_s q_{s,c} E[frqinsp_{s,c,j}] \tag{1-1}$$

where $q_{s,c}$ is the share of firms of size s in cell c. This corresponds to the method known as Goodman's equation in the ecological regression literature (Swamy and Tinsley, 1980; Bidani and Ravallion, 1997). This literature tries to relate aggregate outcomes of populations to characteristics of their components.

As each SRTE may have its own policy, we could run separate regressions by jurisdiction. We model policies $g_j(s, ., a)$ as a linear functions of distance, with separable size and sector coefficients:

$$g_j(s, dist(m), a) = p^{00}_{j,s} + p^{10}_{j,s} dist(m) + p^{01}_{j,a} + p^{11}_{j,a} dist(m), \tag{1-2}$$

In this case, SRTE j policy can be estimated by running a linear regression of the left hand term in (1-1) on interactions of distance with shares $q_{s,c}$, $s = 0, 1, ...9$, "new" and "CNAE Division" indicators $1(div(a) = d)$, $d = 1, 2, ...87$. Figures 5-7 show estimates of mean inspection frequency for different firm sizes in each state, obtained by subtracting the mean from the controls and considering deviations from mean distance. Remarkably, all coefficients assume reasonable values: none is negative and significant, and only in few cases it is possible to reject that they are non-decreasing in firm size.

Next, instead of allowing for arbitrarily different policies, we focus on the interaction between distance and ratio of AFTs per firm and estimate the model described below. We test for systematic differences in policy across states with different number of inspectors, as found by Almeida and Carneiro (2012).

$$\begin{aligned} frqinsp_{c,j} = & \sum_s [\beta_{0s} q_{s,c} + \beta_{1s} q_{s,c} dist_m] + \\ & \sum_{s \neq 1} \beta_{2s} q_{s,c} logAFT_j + \sum_s \beta_{3s} q_{s,c} logAFT_j dist_c \\ & + controls_m + \varepsilon_c \end{aligned} \tag{1-3}$$

This exercise is identical to the one employed by Almeida and Carneiro (2012), except by the fact that we have data disagregated by sector (besides municipality) and we use the number of formal firms reporting to RAIS, instead of the number provided by “Cadastro Central de Empresas”. As we can note in Table 1.1, the general dependence of inspection intensity on size and distance remains valid. However, interactions between number of inspectors and distance were nonsignificant in most cases, and generally negative, contrary to the effect noted by Almeida and Carneiro. Instead, states with greater supply of inspectors appear to be more capable of monitoring smaller firms, regardless of distance.

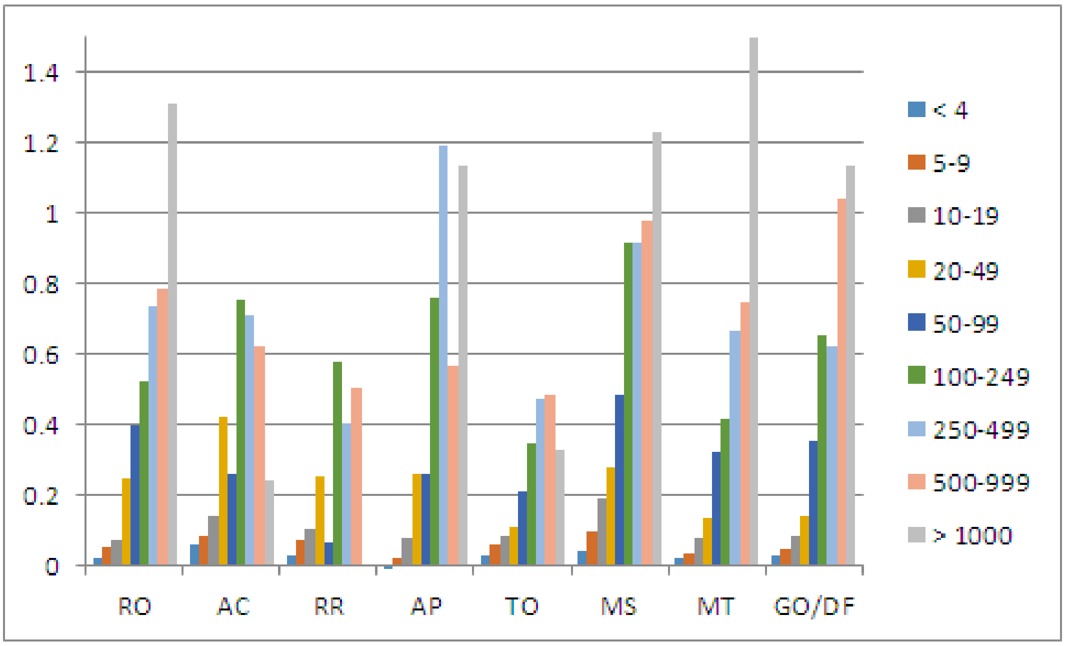


Figure 1.6: Mean yearly inspection frequency, state regression.

1.5.3 Empirical duration model

In the second step of our exercise, we estimate a Cox proportional hazards model for the firing hazard. Our sample consists of all workers with CLT open-ended contracts, working for private firms. Cox model imposes the following specification for the firing hazard:

$$h_{i,c,j,t} = h_0(t) \times \exp(\beta frqinsp_{c,j} + \beta_{after} frqinsp_{c,j} 1(t \geq 365) + controls) \tag{1-4}$$

We consider two tenure intervals: all tenures up to two years and tenures from 334 to 395 days. The first exercise captures effect on overall turnover at

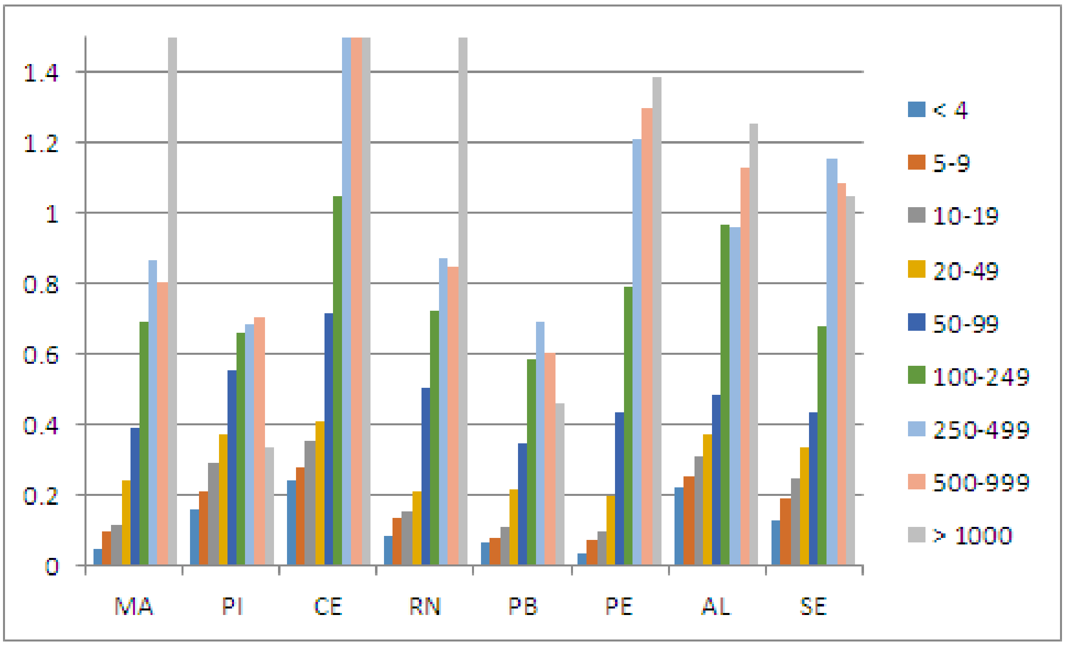


Figure 1.7: Mean yearly inspection frequency, state regression (continued).

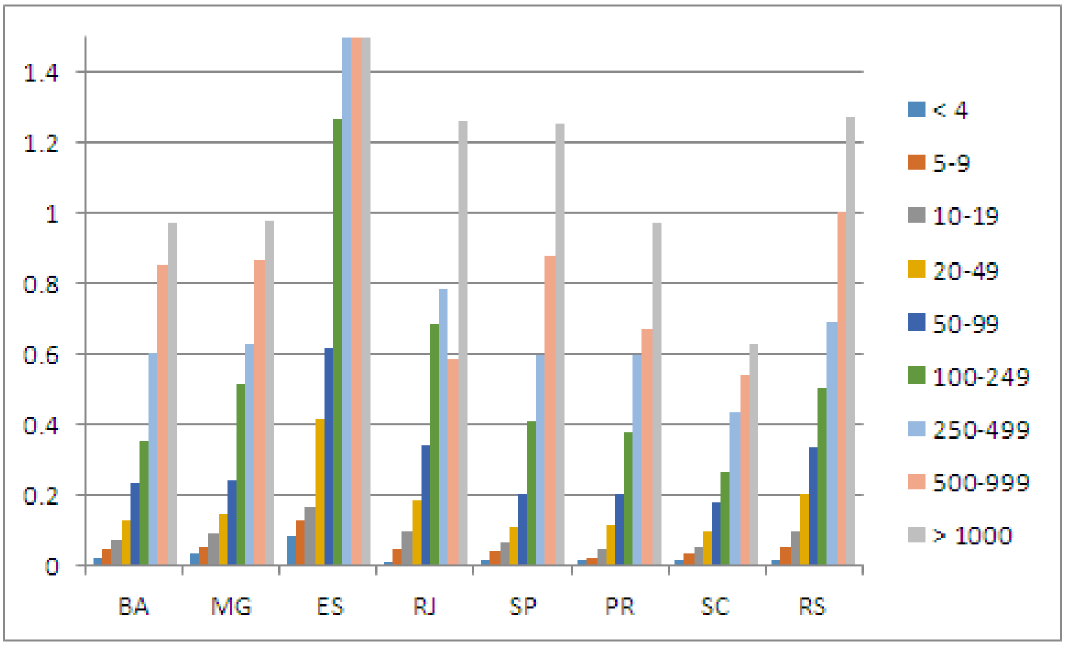


Figure 1.8: Mean yearly inspection frequency, state regression (continued).

Table 1.1: Inspection frequency model

Dep. Variable: *frqinsp*	base		Interaction x dist(m)		x log(#insp/10000firms)		x dist(m) x log(#insp/...)	
share 0 employees	-0,073	[0,0757]	0,011	[0,022]	0,0773	[0,0319] *	-0,017	[0,0064] *
share 1 to 4	-0,080	[0,0747]	0,012	[0,021]	0,045	[0,0159] *	-0,012	[0,0059]
share 5 to 9	-0,027	[0,0746]	0,001	[0,022]	0,060	[0,0192] **	-0,008	[0,0068]
share 10 to 19	0,015	[0,0755]	-0,002	[0,0214]	0,106	[0,0266] **	-0,012	[0,0062]
share 20 to 49	0,115	[0,0735]	-0,010	[0,023]	0,193	[0,0379] **	-0,021	[0,0139]
share 50 to 99	0,281	[0,0788] **	-0,028	[0,027]	0,284	[0,0394] **	-0,014	[0,0209]
share 100 to 249	0,517	[0,0847] **	-0,098	[0,0293] **	0,490	[0,1046] **	-0,078	[0,0288] *
share 250 to 499	0,735	[0,1059] **	-0,144	[0,0335] **	0,261	[0,1845]	-0,008	[0,0545]
share 500 to 999	0,708	[0,1117] **	-0,114	[0,0365] **	-0,079	[0,1629]	0,047	[0,0482]
share 1000+	1,203	[0,1463] **	-0,219	[0,0764] **	-0,059	[0,3424]	-0,154	[0,1821]
share new firms	-0,058	[0,0763]	0,009	[0,0208]	0,077	[0,0148] **	-0,016	[0,0046] **
controls	geographic, institutional and labor market variables at municipality level; interactions between dist(m) and state-level variables							
mean log(#insp/10000firms) = 2,06077 (d. p. = 0,4269276)								

the first and second year, whereas the second estimation is intended to capture the effects near the discontinuity. Estimation is carried separately for each firm size group and uses as controls, besides the same variables considered for estimation of inspection frequency, the workers' characteristics: age, schooling, gender and race.

Results for tenures up to two years are presented in Table 1.2. It is possible to observe that, for smaller firms, namely those with up to 249 employees, an increase in inspection intensity is associated with higher hazard ratios in the first year. The importance of this effect gradually decreases with firm size. While for firms with up to 4 employees an increase in inspection frequency by one percentage point per year is to increase firing hazard by 4.41%, the same change implies a variation of just 0.19% in firing hazard of firms with 99 to 249 employees.For firms with 49 employees or less, there is also a reduction in second year hazards relative to the first year. However, net effect for these firms is positive, meaning that inspection increases turnover even in the second year.

Another important determinant of firing hazards are worker level variables. The results show that older and more educated workers present smaller hazards. Workers that are 20 to 24 years old when started at the job exhibit 10-13

Table 1.3, which presents the estimates for the model around the discontinuity, shows that the same firms that have firing hazards increasing with inspection also have a widening discontinuity at 12 months. Finally, there

Table 1.2: Firing hazard model

	firm size								
	up to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000+
Cox proportional hazard model – tenures from 0 to 731 days									
freqinsp	3.754	2.191	1.281	0.921	0.828	0.197	0.004	0.992	-0.585
	(20.38)**	(22.07)**	(15.24)**	(17.19)**	(18.05)**	(6.55)**	(0.11)	(13.56)**	(33.27)**
freqinsp × 1(t≥365)	-1.866	-1.093	-0.616	-0.21	-0.08	0.058	-0.012	0.138	0.326
	(51.18)**	(33.96)**	(24.16)**	(12.06)**	(5.01)**	(5.50)**	(0.87)	(5.43)**	(24.81)**
schooling									
0-3 years	0.235	0.185	0.192	0.192	0.227	0.293	0.359	0.379	0.488
	(36.09)**	(26.56)**	(30.79)**	(38.02)**	(40.98)**	(59.53)**	(61.13)**	(60.77)**	(106.6)**
4-7 years	0.123	0.112	0.144	0.152	0.18	0.254	0.276	0.249	0.278
	(38.40)**	(33.45)**	(46.93)**	(56.81)**	(56.60)**	(83.93)**	(72.94)**	(59.14)**	(80.58)**
8-10 years	0.086	0.084	0.098	0.122	0.144	0.205	0.214	0.182	0.178
	(37.51)**	(35.22)**	(43.20)**	(58.66)**	(55.04)**	(79.19)**	(63.27)**	(46.88)**	(55.40)**
12+ years	-0.134	-0.183	-0.255	-0.305	-0.372	-0.42	-0.452	-0.46	-0.368
	(31.88)**	(40.11)**	(59.34)**	(79.14)**	(79.61)**	(93.60)**	(80.44)**	(71.32)**	(74.14)**
age									
16-20 years	0.055	0.078	0.086	0.076	0.059	0.066	0.033	0.086	-0.008
	(15.70)**	(21.37)**	(24.43)**	(23.30)**	(14.40)**	(15.75)**	(5.75)**	(12.96)**	(1.76)
20-24 years	0.112	0.126	0.126	0.123	0.109	0.11	0.097	0.115	0.109
	(44.63)**	(48.34)**	(51.78)**	(55.70)**	(40.45)**	(42.29)**	(29.67)**	(31.04)**	(39.42)**
35-49 years	-0.151	-0.154	-0.149	-0.139	-0.132	-0.138	-0.132	-0.151	-0.149
	(56.10)**	(54.80)**	(56.85)**	(59.61)**	(46.81)**	(51.39)**	(39.36)**	(40.43)**	(50.50)**
50-65 years	-0.292	-0.289	-0.266	-0.252	-0.227	-0.248	-0.248	-0.264	-0.229
	(63.39)**	(56.93)**	(56.37)**	(60.87)**	(45.91)**	(52.35)**	(41.55)**	(39.83)**	(42.45)**
other controls	geographic, institutional and labor market variables at municipality level; interactions between dist(m); and state-level variables								
N	3,499,049	3,287,914	3,760,787	4,624,860	3,182,094	3,548,968	2,385,144	1,926,476	3,472,772

Note: t-statistics in parentheses. *: significant at 5%; **: significant at 1%.

is mixed evidence of inspection effects for very large firms. For firms with 100-249 and 1000 or more workers, the discontinuity does not appear to be affected, while for those with 250-499 and 500-999 workers, it appears to be reduced by an increase in inspections.

1.5.4 Discussion

We propose that the response of firing behavior to homologation reflects the fact that this procedure allows the worker to recapture unpaid benefits accumulated through the labor relationship. The discontinuity in the hazard around one year is thus related with homologation being perceived as a relevant firing cost by firms that do not comply with regulations. This is consistent with our description of the institutional setting. Noncompliance with labor regulations such as contributions to FGTS is pervasive. But firing a worker

Table 1.3: Firing hazard model

	firm size								
	up to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 to 249	250 to 499	500 to 999	1000+
Cox proportional hazard model – tenures from 334 to 395 days									
freqinsp	4.475	3.227	1.924	1.179	0.749	0.188	0.052	0.746	-0.534
	(7.65)**	(9.77)**	(6.60)**	(6.17)**	(4.45)**	(1.70)	(0.45)	(2.78)**	(7.51)**
freqinsp × 1(t≥365)	-3.077	-1.958	-1.067	-0.446	-0.327	-0.032	0.093	0.442	-0.03
	(26.90)**	(19.00)**	(12.82)**	(7.99)**	(6.20)**	(0.90)	(2.16)*	(5.40)**	(0.68)
schooling									
0-3 years	0.156	0.201	0.24	0.219	0.281	0.359	0.441	0.347	0.643
	(6.99)**	(8.53)**	(11.12)**	(12.18)**	(13.74)**	(19.95)**	(20.57)**	(14.44)**	(33.84)**
4-7 years	0.108	0.14	0.149	0.155	0.24	0.235	0.249	0.217	0.295
	(10.41)**	(12.58)**	(14.02)**	(16.26)**	(20.82)**	(21.13)**	(17.86)**	(14.25)**	(22.52)**
8-10 years	0.093	0.086	0.106	0.137	0.176	0.207	0.192	0.19	0.231
	(12.73)**	(10.76)**	(13.59)**	(18.51)**	(18.59)**	(22.14)**	(15.62)**	(14.03)**	(19.51)**
12+ years	-0.057	-0.106	-0.185	-0.236	-0.254	-0.288	-0.369	-0.388	-0.31
	(4.41)**	(7.25)**	(12.99)**	(18.14)**	(16.20)**	(19.40)**	(19.61)**	(18.55)**	(18.54)**
age									
16-20 years	0.044	0.056	0.055	0.069	0.079	0.119	0.085	0.106	0.051
	(3.97)**	(4.52)**	(4.44)**	(5.87)**	(5.22)**	(7.71)**	(4.00)**	(4.37)**	(2.73)**
20-24 years	0.093	0.098	0.085	0.099	0.092	0.094	0.081	0.107	0.11
	(11.47)**	(11.19)**	(9.99)**	(12.52)**	(9.35)**	(9.93)**	(6.70)**	(8.14)**	(10.34)**
35-49 years	-0.101	-0.135	-0.132	-0.136	-0.146	-0.16	-0.118	-0.148	-0.129
	(11.82)**	(14.53)**	(14.88)**	(16.82)**	(14.43)**	(16.57)**	(9.81)**	(11.16)**	(11.60)**
50-65 years	-0.207	-0.24	-0.264	-0.254	-0.243	-0.257	-0.241	-0.187	-0.23
	(14.34)**	(14.59)**	(16.43)**	(17.78)**	(13.85)**	(15.27)**	(11.36)**	(8.33)**	(11.56)**
other controls	geographic, institutional and labor market variables at municipality level; interactions between dist(m); and state-level variables								
N	2,252,704	2,077,606	2,326,547	2,825,792	1,931,433	2,158,525	1,475,682	1,206,681	2,110,014

Note: t-statistics in parentheses. *: significant at 5%; **: significant at 1%.

with tenure longer than twelve months implies facing homologation, which will detect any FGTS debt. As the fine is relatively high, in practice the firm should collect the overdue contributions for this worker[9]. It can be noted that the logic of FGTS system is reversed when the main mechanism available to enforce the contributions is their verification upon separation. This just turns the (overdue) contributions into an effective firing cost (instead of a provision accumulated during the employment relationship).

This interpretation is compatible with heterogeneity in the firing hazard profiles both across firm size and inspection intensity. When inspection actually implies in increased compliance of mandated benefits, it should reduce the discontinuity at twelve months. If noncompliance is higher among smaller firms, since they do not receive much attention from Labor Ministry's inspectors,

[9] As we discuss in Section 1.3, this is clearly true at least for contracts just over this threshold.

then one should expect greater effective firing costs (more accumulated unpaid benefits) after twelve months. Conversely, large firms have little chance to systematically violate regulations without being caught by labor inspectors. This explains why inspections would eventually substitute for homologation, and is consistent with the firing hazard not being discontinuous at twelve months for large firms.

The reversion of the relation between inspection intensity and the discontinuity in small firms, as well as the positive relation between inspection intensity and the firing hazard during the first year can also be explained in the context of the proposed interpretation, if the firms react in a different way. As characterized by Camargo (2006), in absence of close monitoring, the firms typically postpone most labor costs until the time of separation, when they can bargain over the overdue benefits. A small enough variation in inspection frequency may be insufficient to cause a change in this behavior. However, once such a firm is caught by a labor inspector, further visits are scheduled in order to verify its regularization. Thus the labor costs of its ongoing employment relationships are raised, since the wage rate cannot be reduced in response to the inspection. It may be profitable to keep certain employees only at the lower costs enjoyed while the firm is not inspected.

In this case, an increase in inspection intensity would both (i) directly accelerate separations – namely, of the relationships that are profitable only if the firm does not pay all the benefits – and (ii) reduce expected profits of the firms' employment relations. The latter effect would also indirectly induce separations, particularly before the 12-month threshold, by reducing firms' willingness to keep long-term relationships. This is consistent with the positive association of inspection frequency with firing hazard both before and after 12 months, but with greater effect on the former (because of the indirect effect), thus generating a wider discontinuity.

The effects just described reflect an environment in which effective labor costs are significantly affected by compliance with regulations. Such an environment should clearly imply deviations of firing behavior from the one that would maximize the labor relationships' surplus, since it generates differences in costs of maintaining equally productive workers. This follows directly from the imperfect inspection coverage – which increases compliance level in a random set of contracts –, but it is worth noting that homologation also yields such cost differences in a systematic and particularly sharp way, when the employment reaches one year. At this point an inefficiently high number of job matches may be dissolved.

A further implication is that, if the benefits are sufficiently valued by the workers, the firm could increase its profits by committing to fully comply with labor regulations. If workers expect to receive the benefits, the firm could then reduce wages accordingly, while overall match surplus should increase with optimal firing behavior. Thus, inefficiency arises from the combination of imperfect enforcement and firms being unable to commit to pay mandatory benefits. Indeed, our discussion of the institutional setting suggests that it should be likely that the firms act opportunistically because of high costs faced by the worker to claim their benefits (long waiting for courts decisions, low probability of being caught and lack of penalties).

1.6 Conclusion

In this paper, we study a prominent feature of firing hazard in Brazil: the discontinuity in separation hazard when the employment relationship completes one year. We have shown that this feature is driven by the firing behavior of small firms, which exhibited a disproportional concentration of dismissals in the first year. We also found that, keeping firm size constant, both discontinuity at the end of the first year and overall hazard at lower tenures increase with the intensity of labor inspection.

These empirical relationships have led us to suggest that discontinuity in firing hazard at one year tenure is caused by non-compliant firms seeking to avoid mandatory homologation of contracts above this threshold. Our discussion of the Brazilian institutional setting supports this hypothesis, as we have argued that homologation should represent a substantial cost from the perspective of a firm that violates the labor laws. We also propose that inspection interacts with this cost structure by reducing the value of longer matches for firms that evade labor regulations. This may explain the intensification of the pattern for firms subject to more frequent inspection.

The proposed explanation yields several interesting implications. First, it provides an example of setting in which stricter enforcement of labor regulations' may lead to increased separation rates, which is at odds with previous findings for another institutional settings, such as those by Fraisse et al. (2009) and Boeri and Jimeno (2005). However, the empirical analysis has also shown that the studied effect disappears for large firms, which face the greatest inspection frequencies. This may indicate that relationship between inspection and turnover may follow an "inverted U" shape: while inspection is not ineffective in reducing non-compliance, it stimulates early terminations; when it is effective, it improves the ability of firms to commit with provision of mandatory benefits and thus starts contributing to reduce separation rates.

Our hypothesis also implies that, in the presence some degree of wage rigidity and noncompliance with labor laws, homologation links the timing of separation to the share of the employment relationship's economic rent appropriated by firm. More specifically, there are two effects. First, by terminating the contract before it completes one year, the employer fully appropriates evasion of labor regulations; otherwise it will eventually have to return some of the benefits it has evaded, because of either inspection or homologation. The other effect is the incentive to delay firing after the contract reached one year, in order to take advantage of imperfect recovery of the total value of evaded benefits at separation. Both effects distort firing decision, from the point of view of economic efficiency.

Finally, our discussion also addresses the desirability of an enforcement device of the type of Brazilian homologation. Although the analysis implies that homologation is effective in detecting and punishing non-compliance independently of inspection resources and geographical location, we find that it fails as a device designed to protect the workers' rights. The reason is that employers that violate the labor laws in a high degree will keep very few – less than half – of the workers they hired for more than one year, and thus few will benefit from this supervision at separation.

2
Tenure dependent firing costs and turnover in Brazil

2.1
Introduction

A well known feature of Brazilian labor market is its high job and worker turnover rates. Roughly 40% to 60% of the workforce changes jobs every year (Corseuil et al., 2013). Turnover is particularly high among low tenure workers. For example, according to Labor Ministry's Relação Anual de Informações Sociais (RAIS) data, in the last ten years, more than one half of the private sector, open-ended employment contracts were terminated before completing one year. At every year in this period, at least 37% of the workers with formal, open-ended contracts in private firms had tenures shorter than 12 months.

These high turnover figures have been pointed as a potential cause of low labor productivity, as they are associated with low employment duration and thus little incentive to specific human capital investments.

The turnover rates contrast with analysts frequently ranking Brazilian labor market regulations among the most strict in the world (Botero et al., 2003; Pierre, 2004; Almeida and Carneiro, 2012). This apparent contradiction has been explained by considering the specific design of these institutions. In fact, while overall regulations are extremely strict, effective firing costs are not particularly high in Brazil. The two main sources of income for dismissed workers are the FGTS system – a seniority payment scheme – and unemployment insurance (UI). Both programs are funded by taxes levied on revenues and payrolls, but firms' costs keep little relation with their turnover behavior.

A strand of the literature on Brazilian institutions (Amadeo and Camargo, 1996; Gonzaga, 1998; Barros et al., 2000; Gonzaga, 2003) points that, besides imposing weak disincentive to firing, the functioning of FGTS and UI may actually subsidize turnover. The basic argument is that, because the major part of the effective firing costs incurred by the firm is paid directly to the worker, they could collude and enjoy a positive net benefit from the separation (access to the FGTS balance plus UI received minus the part of firing penalty paid to the government).

Another distortion, pointed out in Chapter 1 is generated by the mandatory monitoring by Labor Ministry or union officials of every labor contract terminated after one year of tenure, called homologation. Employers subject to weak enforcement, such as small firms and those located far from labor inspection offices, may avoid many labor benefits, notably the FGTS. This makes homologation costly, because it can lead to detection of the evasion, and thus provides an incentive for terminations at tenures shorter than one year.

This paper quantifies the *direct* effect of these distortions, i.e., how the resulting structure of firing costs affects turnover, profits and productivity, and how those outcomes would change if the incentives were eliminated. We propose a model of endogenous turnover based on learning about match quality and firing costs induced by Brazilian institutions. Firms' separation decision reflect a trade-off between finding an employee with high productivity at the job and reducing labor costs.

We build on a learning and turnover model first studied by Jovanovic (1979). This model assumes that productivity is unknown at the time of hiring, but is revealed during the existence of the employment relationship. Firing occurs when the firm finds strong enough evidence of a low match productivity. We incorporate a realistic modeling of labor costs in Brazil comprising wages, compliance with regulations (modeled as payroll benefits valued by the workers) under imperfect enforcement and firing costs.

The model generates a rich description of firing dynamics, which can be compared with empirical turnover behavior and used in maximum likelihood estimation of the parameters. We use administrative data from Labor Ministry covering virtually all formal employment relationships. The results show that the distortions introduced by regulations, together with learning about match quality, explain well the shape of the empirical firing hazard. Our findings thus support the idea that distortions have a sensible influence on turnover strategy of the firms.

Simulations based on the fitted model show, however, that the impact of removing the distortions on match expected profits, productivity and duration are small. Although collection of UI and avoidance of homologation distort firing hazard rates, the effects are concentrated in short intervals of time.

We conclude that, although distortions resulting from the design of Brazilian labor market institutions do shape the timing of dismissals, their effects are of relatively little importance in explaining the overall turnover rates when compared with learning. It is worth emphasizing, however, that we only address the response of *firing behavior* to the effective firing costs implied by the institutions studied. This analysis should be complemented by the study of incentives the same institutions provide to investment in jobs by employers and employees, monitoring, etc.

This paper is divided in seven sections. After this introduction, we describe Brazilian labor market institutions that affect turnover decisions. Next, we develop our model of endogenous turnover and show how the incentives provided by those institutions may affect firms' firing behavior. In section, we discuss our empirical method, describing the RAIS data and presenting our maximum likelihood estimation procedure. Section 5 presents estimation results. We use fitted models to perform simulations in section 6. Finally, section 7 concludes.

2.2 Institutional setting

We begin by describing the relevant labor market institutions and their potential effects on incentives faced by the firms' turnover decisions. Later in this section, we present empirical data showing how separation and, specially, firing behavior reflect influence of the institutions.

In Brazil, formal employment relationships are ruled by labor legislation, mainly the labor code – or CLT (Consolidação das Leis do Trabalho) – and the Constitution, which provide a minimum standard for labor conditions. The CLT established regulations over working time, benefits and workplace safety. These were greatly expanded by the 1988 Constitution (see, e.g., Gonzaga (2003)). Most of formal labor contracts – approximately 80% of the total and 95%, if public administration is excluded[1]– are open-ended contracts under CLT, requiring compliance with legal termination procedures and compensations for the workers dismissed without just cause.

2.2.1 Firing costs

Brazilian firms are generally allowed to lay-off employees without justification. The exceptions are set by stability rules, which essentially apply to workers returning from sick leave caused by workplace accident, those which are pregnant or gave birth in the last five months, and elected union representatives. Those can only be dismissed with just cause. In other cases, the main constraint to unjustified dismissals is paying compensations and following certain procedures, as we shall discuss.

[1]Civil servants' labor contracts are governed by a different legislation.

In practice, firms can also avoid firing costs for the first three months of the employment relationship. The legislation allows the firm to propose an "experience contract" of up to 90 days. At the end of this contract the firm can dismiss the employee without cost, or convert it into a open-ended one, incorporating the current tenure. If the initial contract is shorter than 45 days, it may also be extended once for a period of equal length. If the firm wants to terminate the experience contract before it ends, however, it needs to pay a penalty equal to half of the wages for the rest of the agreed period plus the firing fine applicable to open-ended contract. Thus, for up to three months, employer faces no constraints to firing besides the indivisibility of the experience period.

When a firm chooses to terminate an open-ended CLT contract, it must give the worker advance notice of dismissal. Until 2011, all workers were granted a one-month advance notice period; more recently this period was extended in three days per complete year of tenure, up to a total of 90 days. After delivering the notice, the firm may either keep the worker at the job, with 25% reduction in daily or weekly working time – to allow the worker to seek another job –, or pay the corresponding wages and dismiss the worker immediately. Further, CLT requires the firm to settle all payments (due wages, benefits and dismissal compensation) one day after the last worked day, in the former case, or ten days after notification, in the latter. As documented in literature – see, for instance, Barros et al. (2000); Gonzaga (2003), employers often choose to just pay the extra wage, suggesting that productivity falls substantially during the notice period.

For dismissal without cause, the firm must pay the worker a fine. Since 1988, this compensation corresponds to 40% of the amount it contributed to dismissed worker's severance fund, the FGTS (discussed below). In 2001 this cost was raised to 50%, with the additional 10% being paid to the government. FGTS balance accumulates at a rate of roughly one monthly wage per year worked, thus firing a worker with two years tenure would entail a fine amounting to monthly wage (0.8 to the worker and 0.2 to the government).

Finally, termination of an employment relationship that lasted at least 12 months must be overseen by the employee's union or a Ministry of Labor's official. This supervision, which is called assistance or "homologation", aims to explain workers' rights and enforce compliance with them.

2.2.2 FGTS system and unemployment insurance

Workers are assisted by two sources of income in case of losing their jobs. On is the FGTS system. Employers contribute monthly to their workers' FGTS (Fundo de Garantia por Tempo de Serviço) accounts with 8% of the wage. Since 2001, firms started to pay an additional of 0.5% of the monthly wage to recover fund's losses with legal disputes over adjustment indexes after monetary stabilization episodes in 1989 and 1990. The fund's balance is available to the worker when he is dismissed (but not when he quits), and thus employer's contribution can be viewed as a provision for severance payment. Indeed, as shown in Gonzaga (2003), the system was designed to approximately match the severance payments in effect under the previous institutional setting.

Since the creation of FGTS system, in 1966, a fine proportional to the accumulated balance and paid directly to the worker was imposed in the case of unjustified dismissals. It was originally 10%, being increased to 40% in 1988. The additional 10% paid to the government, mentioned in the previous sub-section, was also a result from the 2001 effort to recover the fund's assets (note that both the 0.5% monthly contribution and the additional 10% firing fine are made to the FGTS system, not directly to the individual workers).

If the worker is not fired from a given job, the FGTS balance accumulated in this job is held in an account in his name, but may only be withdrawn when he retires, or in some exceptional cases such as: HIV, cancer or terminal illness; urgent need related to natural disaster, subject to ordinance by federal government recognizing disaster or emergence; purchase of own home or payment of mortgage related to such a purchase.

Besides the access to FGTS balance, workers dismissed after at least six months in the job are eligible to unemployment insurance. Monthly UI benefits' value is calculated as a function of earnings at the lost job, while the maximum duration is related to the length of employment spells over the last three years.

Replacement rates, the ratio between the benefit and the wage earned in the most recent job, are high for low wages. The benefit is bounded from below by the minimum wage (mw), which is paid for workers who received up to 1.25 mw, resulting in a replacement rate decreasing from 100% to 80% in this range. Until 2012, workers earning between 1.25 and 1.65 mw had a replacement rate of exactly 80% (currently this bracket has been narrowed to 1.25-1.60 mw). For higher wages there is a further range, until 2012 between 1.65-2.75 mw (currently: 1.60-2.65 mw), where the marginal replacement rate is 50% and above this the benefit is fixed at its ceiling of 1.87 mw (1.80 mw).

The worker is entitled to a maximum number of installments according to the number of months he was employed in the last three years. UI is paid for three months, if the worker was employed for six to eleven months; four, if employed for 12 to 23 months; and five, if employed for 24 to 36 months.

UI is funded by contributions levied on firms' gross revenues (PIS). Despite Constitutional ruling allowing the creation of a specific contribution to be charged from firms with high turnover, this has never been implemented. Therefore, firms share the costs of UI independently of their turnover, i.e., there is no experience rating.

2.2.3 Distortions related to FGTS and UI

Many analysts of Brazilian labor market have pointed that the design of the institutions discussed above generates incentives for an excessive, artificial, number of lay-offs. Basically, it is noted that as a result of the design of UI and FGTS funding, effective firing costs comprise only the FGTS fine and the advance notice. Further, the major part of those costs (80% of the FGTS fine and 100% of the advance notice) is paid to the worker. As the worker, when fired, also becomes eligible to receive the UI – subject to a tenure of at least six months – and access FGTS balance, he or she can actually benefit from the lay-off and there may be even a net gain from the viewpoint of the employer-employee relationship. This can lead employees to seek to be fired or to collude with the employer to perform a "fake lay-off", i.e., to stage a lay-off when actually the worker wanted to quit or even continue the relationship informally. The worker is able to compensate the firm, e.g., by returning the firing fine and giving up the advance notice, because of relationships' net gain.

The first academic work on this subject we are aware of is the book by Macedo (1985). They argue that FGTS system may have contributed for a raise in Brazilian turnover rates since its implementation due to two reasons. The first is that FGTS turned the existing firing fine into a provision, collected regardless of occurrence of the lay-off, then reducing the impact of turnover strategy on firms' income flow. The second effect was the distortion caused by the willingness of the workers to withdraw the FGTS balance. In order to evaluate this possibility, they conducted a survey with individuals withdrawing from their FGTS accounts. The results show that 8.5% of the respondents declared they made an agreement with the employer in order to be fired without cause. Macedo (1985) note that this number may understate the actual proportion of disguised lay-offs because of under-reporting and due to the survey being conducted during a recession, when incentives for quitting are reduced.

Amadeo and Camargo (1994, 1996) point out that FGTS system induces workers to do on-the-job search and to seek to be fired, thus being able to access their FGTS balance more often, instead of waiting until retirement. They argue that this incentive is particularly strong in jobs with little promotion opportunities, so that immediate income flow has greater relative importance, and when unemployment rates are small and thus the worker may expect to find another job quickly. Amadeo and Camargo (1994) also underscore the lack of conditionality in UI system and point out that the workers could collude with their employers in order to simulate dismissals – possibly negotiating the reimbursement of the FGTS fine –, enjoying the UI and FGTS balance while actually continuing (informally) at the job.

Ramos and Carneiro (2002) contend the view that FGTS system promotes excessive turnover, in the sense that workers are penalized by their own behavior. They argue that rational workers would not induce their own lay-offs if the jobs offered opportunities of greater income along with longer tenures. Therefore, high turnover is a "demand side" issue, i.e., should be attributed to the type of jobs available, which reward tenure poorly. Empirically, they note that informal sector tenures tend to be even shorter than formal sector's. Further, using a time series of macroeconomic data, they also find a structural break in turnover trend in the early 90's, thus shortly after the increase of FGTS fine in 1988 and in a period when UI coverage was quickly growing. They conclude that the drop in turnover level after the break is an evidence against the hypothesis of these benefits' entailing perverse incentives.

Gonzaga (2003) studies the effects of the two episodes of variation in the firing costs – 1988 and 2001 – using data from Brazilian monthly employment survey (PME). Particular attention is devoted to the fake lay-offs. Gonzaga (2003) distinguishes the effects of the firing penalty paid to the worker and the one collected by the government. The former makes the lay-off more desirable for the worker but also makes harder to reach a fake lay-off agreement, with ambiguous effect on turnover; the latter has unambiguous effect by reducing gains from fake lay-offs without changing attractiveness of high turnover behavior for the employees. Along these lines, Gonzaga (2003) argues that Ramos and Carneiro (2002) results are actually consistent with the occurrence of fake lay-offs.

2.2.4 Homologation

Another distortion in firing behavior is caused by mandatory homologation after 12 months of tenure, as identified and described in detail in Chapter 1. Essentially, homologation is a necessary condition for receiving UI and FGTS, which makes it very hard to avoid. Further, the procedure investigates compliance with labor regulations during the employment relationship, including the proof of collection of all FGTS contributions. The penalty imposed when some irregularity is detected easily exceeds the costs of compliance for moderate tenures (not much longer than one year), thus it is better for the firm to pay the overdue benefits than to be caught at the homologation meeting. Therefore, homologation turns any evaded benefit into a firing cost if a lay-off is made after the employment relationship completes one year.

This is particularly important for small firms and those located far from the municipalities where the Ministry of Labor's inspection offices are located. Those firms face weak enforcement in form of inspections and evasion of labor regulations, notably of FGTS obligations, is widespread among them.

2.2.5 Labor market institutions and firing hazard

To observe how the institutions just discussed affect turnover, we compute aggregate empirical separation hazard function from RAIS data – which will be described below, in section 5. The hazard function regarding a given event is defined as the probability of occurrence of the event at each time, given that it has not occurred before. In this case, it is the probability of a job relationship, that reached a given tenure, being terminated at that moment. The empirical counterpart, which we calculate, is given by the proportion of jobs terminated at given tenure to the total of contracts that reach this tenure.

The results, for selected years, are presented in Figure 2.1[2]. The graph shows that turnover is particularly high among low tenure workers. Indeed, in the considered period, more than one half of the contracts was terminated before completing one year.

[2]We discretize tenure as follows: tenure variable t equals m if the contract lasted for $m-1$ months plus fifteen days up to exactly m months; t equals $m+0.5$ if lasted m months plus one to fourteen days. This discretization was chosen because, for UI purposes, five months plus fifteen days is equivalent to six months. However we note that this produces an imbalance in the size of bins, as "exact" bins include 14 to 17 days, while "half month" bins always contain only 14.

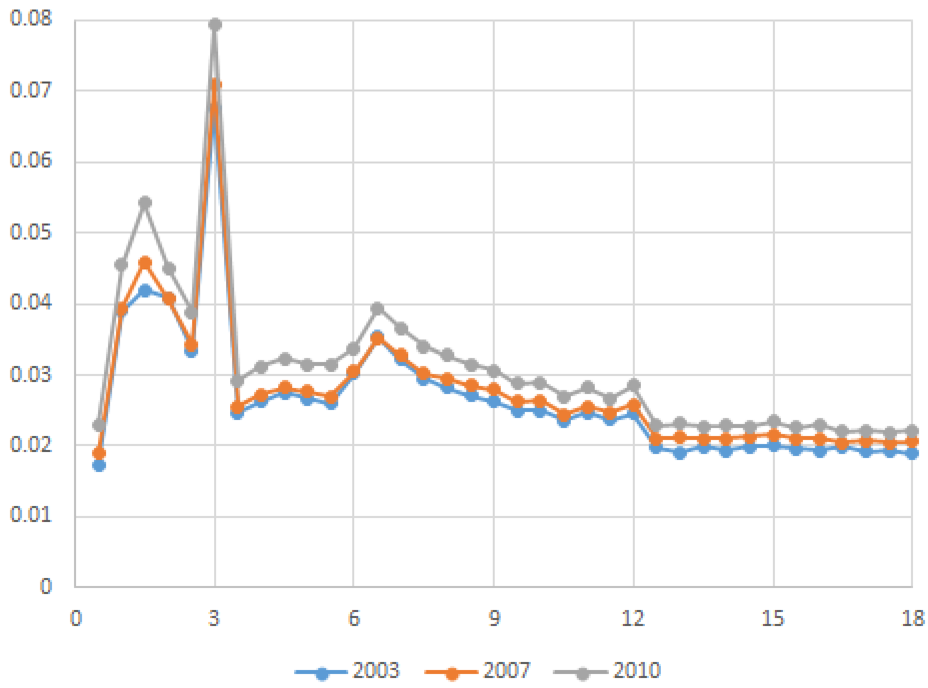


Figure 2.1: Aggregate firing hazard. Source: Elaborated by the authors.

Further, it can be noted that the shapes of those hazard functions are remarkably similar across years, and always exhibit the same patterns around three, six and a half, and twelve months. Hazard rates, which are increasing just before three months, drop discontinuously immediately after that point. At six and a half months a similar effect takes place in the opposite direction, with hazard exhibiting a discontinuous positive jump. Finally, at twelve months, we have again an increase followed by a discontinuous drop. Figure 2.2 decomposes separation hazards in 2010 according to which part initiated the separation and the reason (whether the worker was fired with just cause or not, quit, and other reasons). It shows that the discontinuities are driven by unjustified lay-offs by firms' initiative.

This behavior is a suggestive evidence of the distortions discussed in this section. The effect at three months clearly reflects the timing of introduction of firing costs (as we have discussed above), which become effective as labor relationship reaches 90 days. Firms seek to anticipate dismissals before they become costly. Behavior of hazard close to six months may be associated with eligibility for unemployment insurance: a firm can delay a dismissal in order to let worker become eligible, either because of benefit sharing or fairness considerations. [3] Finally, firms appear to avoid homologation by anticipating

[3]One may note, however, that this spike does not match precisely the threshold for UI eligibility. A possible explanation for this is that many agents may be unaware of the rule of rounding up the sixth month.

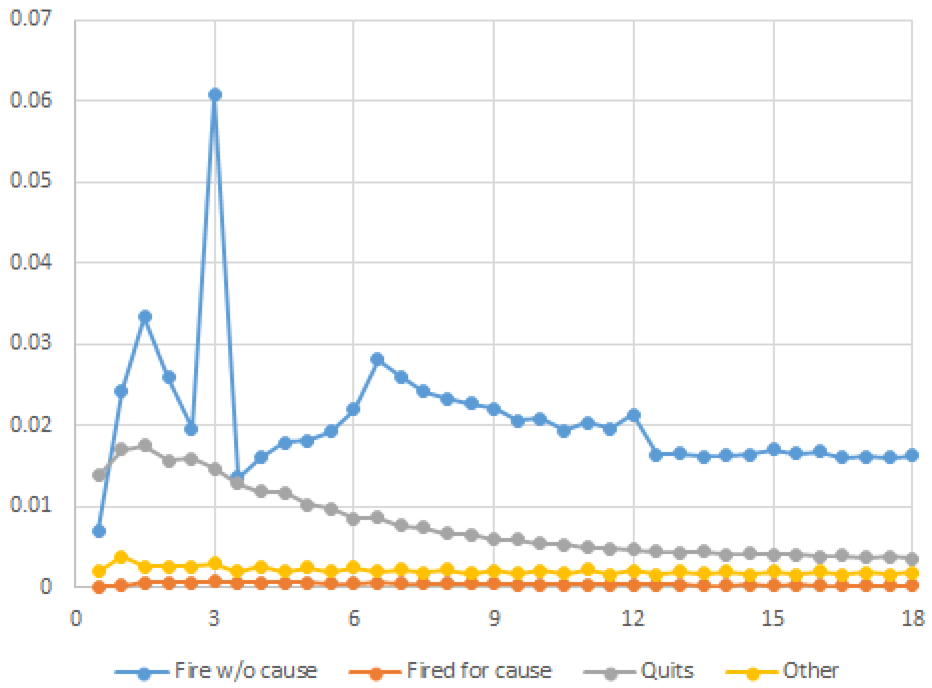


Figure 2.2: Separation hazard by initiation and reason. Source: Elaborated by the authors.

dismissals close to one year tenure.

2.3 The model

In order to assess the potential impact of the distortions on labor market outcomes, we propose and estimate a model of endogenous turnover incorporating those features.

The main ingredient of the model is learning about match quality. Productivity is unknown at the time of hiring, but is revealed as production takes place. Firing results from the firm finding strong enough evidence of a low match productivity. The core learning and turnover model on which we build ours was first studied by Jovanovic (1979), in a slightly different context, where the worker collected all the rent (with flexible wages) and had to decide to continue at his current job or to pay a separation cost to move to another. Marinescu (2007) studies this model in the same context as us, where the firm decides whether to continue an existing match, and extends it, allowing for shocks on the true match quality.

Consider an employment relationship beginning at time $t = 0$. Before production takes place, the firm and the worker set a wage rate. We consider, but do not explicitly model, that wage is set by bargain. When bargaining takes place, the firm does not know worker's productivity in the job it controls, and bases its decision on a prior distribution $\Phi_0(.)$.

Each period $t \geq 0$, production takes place along with the observation of a signal about match quality[4]. It is also observed whether an inspection has occurred, which every period has probability p to happen, or not. After that, the firm chooses whether to continue the match or separate, based on its updated belief about match quality F_t. If the firm decides to continue the relationship, the worker may choose to quit or to continue. We assume that every period the worker has a fixed probability q of quitting. If and only if both the firm and the worker choose to continue, those steps occur again at period $t+1$.

Every production stage, the firm receives a profit flow equivalent to the expected productivity of the match minus labor costs. Denoting by w the wage rate including all benefits – such as full contribution to FGTS and correct overtime pay –, we assume that at the beginning of every employment relationship the firm pays $w_n = (1-\eta)w$. We refer to such match as being in "non-compliant" state. While in this state, the firm accumulates a liability P_t, corresponding to the flow of evaded benefits ηw corrected by a rate $\tilde{r}$. Therefore, at any given t:

$$P_t = \begin{cases} \eta w (1+\tilde{r}) \frac{(1+\tilde{r})^t - 1}{\tilde{r}}, & \text{if } \tilde{r} \neq 0 \\ \eta w t, & \text{if } \tilde{r} = 0 \end{cases} \tag{2-1}$$

We assume that $\tilde{r}$ is less than r, the economy's interest rate, reflecting low returns to FGTS funds, difficulty to claim past benefits, and the fact that there is seldom any punishment for non-compliance: a common outcome of labor courts is the payment by instalments, with little or no correction, of the amount of overdue benefits (Cardoso and Lage, 2007). This is consistent with Camargo's (2006) view that it is optimal to the firm to postpone the payment of benefits as much as possible, eventually negotiating them upon termination.

We model inspection as a costs shock that arrives at a constant rate p. Once inspected, the job is said to be in "inspected" state and has its costs permanently changed. The wage rate increases from w_n to w, as the firm must start to comply with all legal benefits, and the firm has to pay P_t, clearing its liabilities related to past evasion. This assumption is supported by the high "rate of regularization" verified in follow-up inspections by the Labor Ministry.

Separation requires payment of firing costs S_t, and if tenure is longer than one year and the firm is not complying with regulations, the collection of the overdue benefits balance P_t. We assume that the value of the vacancy

[4]There is an equivalent setting in which the observed output, which is stochastic, is itself the signal (Jovanovic, 1979). Since the firm is risk neutral and must decide whether to continue after observing the signal, the expected reward is unchanged.

controlled by the firm is zero, as would arise from a search and matching model with free entry. The modelling of S_t introduces two institutional factors: the effective firing penalties induced by legislation and the distortion related to the willingness of workers to access lay-off rent.

As discussed earlier, legal firing costs comprise a one-month advance notice and the fine corresponding to 50% of FGTS balance and is applicable after the experience period. We consider that advance notice costs one full monthly wage (consistent with productivity during notice period being zero), and recall that FGTS equals 8% of accumulated wages, resulting in a firing fine of 4% of a monthly wage per tenure month.

With respect to the distortion, we focus on the receipt of UI, as access to FGTS balance should play a minor role for short tenures, and model it as a reduction in firing costs when the worker becomes eligible. This reflects the possibility of the firm and the worker effectively sharing the "separation surplus"[5]. In summary, we consider:

$$S_t = \mathbb{1}(t > T_E) \times (1 + 0.04m(t))w_{mo} - \mathbb{1}(t > T_{UI}) \times \Delta S_{UI}$$

where $\mathbb{1}(t > T_E)$ and $\mathbb{1}(t > T_{UI})$ are indicators of tenure exceeding the experience period and the UI eligibility threshold, respectively; $m(t)$ is the equivalent of t in months; w_{mo} is the monthly wage; and ΔS_{UI} the perceived reduction in firing cost associated with unemployment insurance.

Regarding the structure of information shocks, we assume that prior belief over match productivity is normally distributed with mean μ_0 and variance σ_0^2. Signals ξ_t, in turn, have a normal distribution with mean equal to the actual match quality and variance σ_S^2, and are independent from each other. We assume the firm observes up to a maximum of T_* signals; after period $t = T_*$, the firm stops learning. Updating by Bayes' Rule leads to a belief Φ_t which is normally distributed with mean y_t and variance σ_t^2 given by:

$$y_t = \frac{\sigma_0^{-2}}{t\sigma_S^{-2} + \sigma_0^{-2}} y_0 + \frac{t\sigma_S^{-2}}{t\sigma_S^{-2} + \sigma_0^{-2}} \bar{\xi}_t \tag{2-2}$$

$$\sigma_t^2 = \frac{1}{t\sigma_S^{-2} + \sigma_0^{-2}} \tag{2-3}$$

where $\bar{\xi}_t = \dfrac{\sum_{s=1}^{t} \xi_s}{t}$, is the mean of observed signals.

[5] We note that firms' concern with fairness or with their workers' welfare would yield an analogous effect. Alternatively, one could consider reduced effort by the worker on the job (resulting from reduced impact of losing the job), which would reduce revenues flow. The effect is also similar in this case, because it reduces the value of continuing the match relative to separation.

2.3.1 State variables, value functions, and the solution of firm's problem

It is useful to rewrite y_{t+1} as follows:

$$y_t = \frac{(t-1)\sigma_S^{-2} + \sigma_0^{-2}}{t\sigma_S^{-2} + \sigma_0^{-2}} y_{t-1} + \frac{\sigma_S^{-2}}{t\sigma_S^{-2} + \sigma_0^{-2}} \xi_t \tag{2-4}$$

This shows that previous belief's mean y_{t-1}, time t, and current signal ξ_t contain all information required to compute the updated belief's mean y_t. Further, it is clear that the variance of belief depends only on time t and parameters. Together, these facts imply that (y_t, t) fully describes firms knowledge about match quality. Let $\mathbb{1}_t^I$ be an indicator of occurrence of inspection at or before t, i.e. $\mathbb{1}_t^I = 1$ if the firm was inspected at some time $\tau \leq t$, and $\mathbb{1}_t^I = 0$ otherwise. Then $(y_t, t, \mathbb{1}_t^I)$ fully describes the state of firm's problem.

The problem can then be stated in terms of the following value functions:

$$\Pi^I(y,t) = \max\left\{y - w + \delta E\left[F(y',1,t)|y,t\right]), -S_t\right\} \tag{2-5}$$

for an inspected match, and

$$\begin{aligned}\Pi^N(y,t) = \max\{ \quad y \quad + \quad & p(-w - P_t + \delta E\left[F(y',1,t)|y,t\right]) \\ + \quad & (1-p)(-(1-\eta)w + \delta E\left[F(y',0,t)|y,t\right]) \\ , -(S_t + \mathbb{1}(t > T_H)P_t) & \quad \}\end{aligned} \tag{2-6}$$

for a never inspected match, where $\mathbb{1}(t > T_H)$ is an indicator of t exceeding one year (and thus, of mandatory homologation of lay-offs) and , since there is no separation costs when a worker quits, the quitting rate q and the discount rate r are combined into the effective discount factor $\delta = \frac{1-q}{1+r}$.

With a finite number of signals $T_* < \infty$ and firing costs S_t satisfying $\lim_{t\to\infty} S_t = \infty$, it is possible to show that the firms' problem may be solved by a finite number of calculations. The argument is as follows. First, note that after the end of learning, a firm would continue a expected match only if $\frac{y_t - w}{\delta} \geq -S_t$. If it is optimal to continue the match with a firing cost S_t, it must be optimal to continue in every subsequent period, when the firing cost will be the same or greater. As inspected matches do not return to "non-compliance" state, the problem of inspected firm can then be calculated in T_* steps by backward induction.

Next, it can be shown that, when homologation becomes mandatory ($t > T_H$), if a match of quality y would be continued by an inspected firm, then it would also be continued by a non-inspected firm. This follows from the fact that, besides the profit flow of non-compliant match is greater than with compliance, with $\tilde{r} < r$, delaying the payment of labor liability reduces its cost in present value. Let y_I^* and y_N^* be the reservation productivity for compliant and non-compliant matches, respectively. Then $y_I^* > y_N^*$ and thus we may distinguish two groups of non-inspected matches: those with $y > y_I^*$ will never be dissolved and those with $y \in [y_N^*, y_I^*]$ may be dissolved after inspected.

Eventually, firing costs become so high (when $S_t \geq -\frac{y_N^*-w}{\delta}, \forall t \geq T^{**}$) that no match with $y > y_N^*$ will ever be dissolved. Thus the problem of a non-compliant firm may be solved numerically by backward induction starting from T^{**}.

2.3.2
Properties and examples

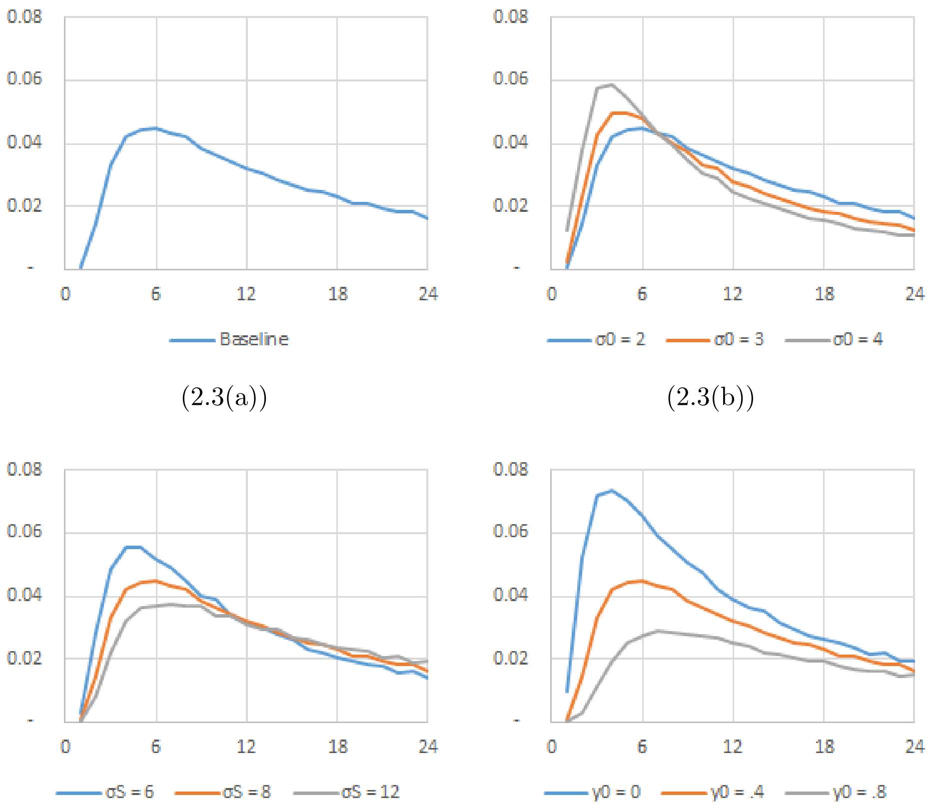
We next analyze some properties and examples of our model, in order to show how it can replicate empirical behavior, and how we expect to recover parameters values from the available information.

Frictionless problem

We first consider firms' choices in an environment free from any regulation. This means we take $S_t = 0$ and every match already starts in "inspected" state. If match quality was known immediately after the job contract is signed, which can be considered as a limiting case with $\sigma_S^2 = 0$ and infinitesimal periods, the firm should clearly continue only those matches with positive profits flows, i.e., $y \geq w$. With non-trivial learning about match quality ($\sigma_S^2 > 0$), some matches with negative profit flows are not immediately dissolved. This happens because, given the possibility to fire the worker, news about match quality have an asymmetric effect on profits. While gains from matches that turn out to be better than expected are proportionally absorbed by continuing the relationship, losses from low quality ones can be bounded by terminating it. As information accumulates, beliefs become more precise and this "option value" decreases, with reservation productivity increasing towards its limit w.

Panel (a) of Figure 2.3 shows the shape of a typical firing hazard profile. A single peak occurs early, when uncertainty – and thus option value – is decreasing rapidly. Later, each new observation adds little information, and option values and expected productivity vary more slowly, which decreases firing hazards. This pattern mirrors actual separation patterns (Mincer and Jovanovic, 1981; Farber, 1999), and can be proved to be a property of the solutions of the firm problem with constant firing cost (Jovanovic, 1979) .

In panel (b), we illustrate the effects of varying σ_S^2. The graph shows that the greater signals' precision is (the smaller their variance is), the more the hazard concentrates in initial periods. This is a straightforward consequence of increased learning speed allowing to terminate bad matches early. Next, the effects of varying prior standard deviation are shown in panel (c). It can be noted that higher σ_0^2 leads to an increase in early separations. Intuitively, this happens because, keeping signals' precision constant, it is easier to identify matches as being above or below the wage rate. Finally, in panel (d) we show how firing hazards change with average match quality y_0. Intuitively, lower mean productivity generates more separations, as more matches are unprofitable.



(2.3(a)) (2.3(b))

(2.3(c)) (2.3(d))

Figure 2.3: Frictionless problem examples. Baseline parameters: $\sigma_0 = 2$, $\sigma_S = 8$, $y_0 = .4$, $w = 1$ and $\delta = .99325$.

Firing costs

We first examine the introduction of a firing cost that remains constant over the time, $S_t = S$. To see what are the implications on firm problem, it is useful to introduce the equivalent problem of maximizing the excess profit over separating. This corresponds to subtracting separation payoff from (i.e. adding firing costs to) the two quantities inside the maximum operator. Denoting by G the excess profits we rewrite the inspected match problems as:

$$\begin{aligned} G^I(y,t) &= \max\left\{y - w + S_t + \delta E\left[\Pi^I(y',t+1)|y,t\right]), 0\right\} \\ &= \max\left\{y - w + S_t + \delta E\left[G^I(y',t+1) - S_{t+1}|y,t\right]), 0\right\} \\ &= \max\left\{y - w + (1-\delta)S_t - \delta(S_{t+1} - S_t)\right. \\ &\qquad \left. + \delta E\left[G^I(y',t+1)|y,t\right]), 0\right\} \end{aligned} \tag{2-7}$$

Note that as it is obtained by adding the same quantity to both continuation and separation pay-off, the "excess profit" problem should have the same solutions as the original firm problem.

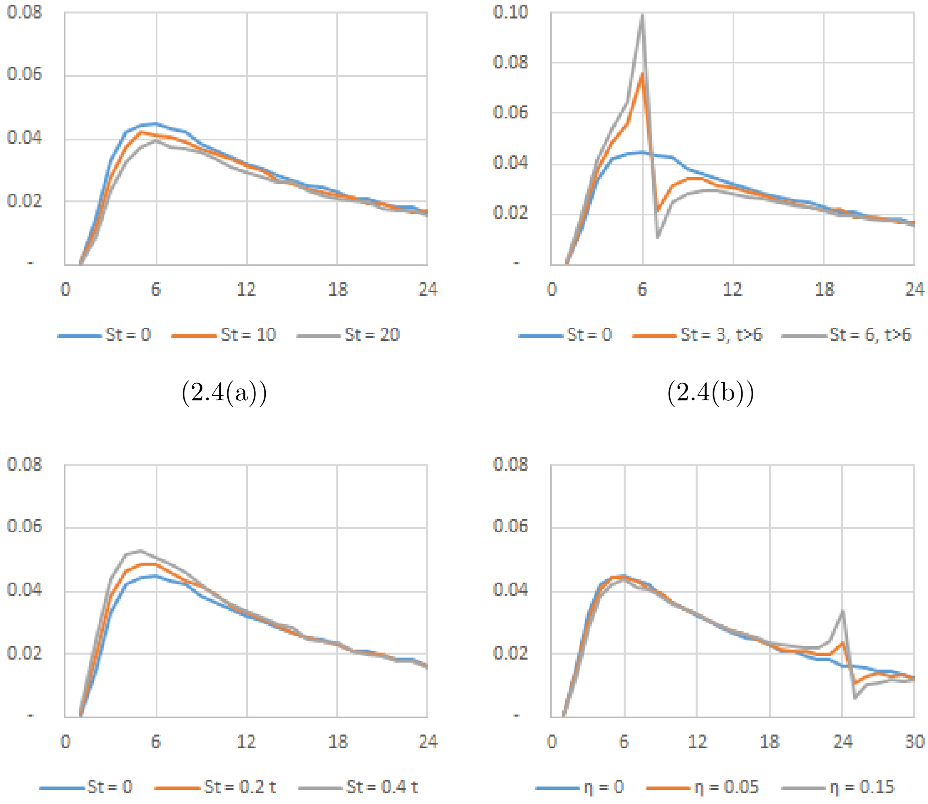
With constant firing costs, $S_{t+1} - S_t = 0$. Therefore, it is easy to see that introducing a constant firing cost S produces the same effect on separation decision as increasing y_0 (or reducing wages) by $(1-\delta)S$, thus reducing firing hazards. Intuitively, continuing the match results in delaying the payment of the firing cost, which saves an amount equivalent to the return over the firing cost S for one period, at the rate $1-\delta$.

Variable firing costs, in turn, generate a different turnover pattern. Panel (b) of Figure 2.4 illustrates the introduction of "step" firing cost. The effect is a distortion of firing behavior around that point, described by Marinescu (2009), as a "spike followed by a trough". This results from the optimal behavior prescribing the anticipated dissolution of matches which otherwise would have a high future separation probability. Interestingly, a firing cost introduced after the employment relationship begins may generate higher overall separation.

In panel (c), one can verify that when linear firing costs are introduced, hazards increase at the beginning of the relationship. Looking at the excess profits formulation of firm's problem (2-7), we note that in this case, the term $-\delta(S_{t+1} - S_t)$ does not vanish. Intuitively, with $S_t = \alpha t$ by delaying the lay-off, the firm saves $(1-\delta)S_t = (1-\delta)\alpha t$ but also accepts incorporating the increase by $\delta(S_{t+1} - S_t) = \delta\alpha$ in firing costs for the next period. This is another case in which firing costs may increase turnover.

Imperfect enforcement

Imperfect enforcement introduces two elements: the random inspections and homologation. In order to analyze their effect, it is useful to write the



(2.4(a)) (2.4(b))

(2.4(c)) (2.4(d))

Figure 2.4: Firing costs and imperfect enforcement examples. Parameters values: $\sigma_0 = 2$, $\sigma_S = 8$, $y_0 = .4$, $w = 1$, $\delta = .99325$, $\tilde{r} = 0$ and $p = 0083$.

excess profit formulation for the non-inspected match:

$$\begin{aligned} G^N(y,t) = \max \{ y - w + & \\ & + (1-\delta)S_t - \delta(S_{t+1} - S_t) + \\ & + (1-p)\eta w + (\mathbb{1}_{(t>T_H)} - p)P_t - \delta(1-p)\mathbb{1}_{(t+1>T_H)}P_{t+1} \\ & + \delta(pE\left[G^I(y',t)|y,t\right] + (1-p)E\left[G^N(y',t)|y,t\right]), 0\} \end{aligned} \tag{2-8}$$

This has two differences from the inspected match problem. One is that the continuation value is a mix of inspected and non-inspected payoffs. The other is the term in the third line, which represents excess profits generated by continuing evasion of labor regulations. Before T_H (with $t < T_H$), this term equals $(1-p)\eta w - pP_t$, meaning that every period the firm saves the evaded benefits with probability $1-p$, but risks paying the accumulated labor benefits with probability p. For the low inspection probability faced by small firms (generally under 20% per year), the first effect tends to dominate at tenures under one year.

When the match is subject to homologation ($t > T_H$), the evasion term is to $(1-p)(1-(1+\tilde{r})\delta)(\eta w + P_t)$, which is positive because $\tilde{r} < r$ implies $(1+\tilde{r})\delta < 1$. This means that after homologation, reservation productivity is lower for never inspected matches, similarly to the effect of a constant firing cost. Intuitively, there is a gain in delaying payment of labor liabilities when they are corrected by less than the discount rate. This gain is reduced by the correction rate and by the chance of inspection, which would force the payment of P_t.

Finally, at the homologation threshold ($t = T_H$), the difference in excess profit flow between inspected and non-inspected matches is $(1-p)\eta w - pP_t - (1-p)\delta P_{t+1}$. This is generally negative because of the $-(1-p)\delta P_{t+1}$, representing the raise in effective firing costs.

The last panel of Figure 2.4 shows the effect of introducing evasion of benefits, with mandatory homologation in period 24. Essentially, the discontinuity generated by homologation is similar to that generated by a stepwise firing cost. As discussed above, the magnitude of the cost introduced is approximately, that of the accumulated evaded benefits balance at T_H. Its effect, however, is reduced by the fact that only non-compliant matches are affected and because, with probability p, the firm can turn out to pay P_t even if it continues.

It is worth noting that imperfect enforcement ($0 < p < 1$) is itself a distortion. It implies the coexistence of two types of match rewarding the firm differently for the same productivity. Therefore, the resulting turnover behavior, which in our model is defined by the firm, cannot be optimal from the point of view or match surplus.

Estimating model's parameters from firing hazards

We expect to recover model parameters from the shape of empirical firing hazards. Particularly, the examples just discussed show that the discontinuities should be roughly proportional to the distortion parameters, while information structure is related to the level and overall distribution of the firing hazard along different tenure levels.

The analysis of the model indicates some difficulties regarding the use of empirical data for finding appropriate parameter values. First, it is worth noting that shifting y_0 and w by the same amount, the optimal firing hazard is unchanged. Therefore one could generate the same results by taking any combinations of these parameters with constant $y_0 - w$. Further, firm's problem is also scale-invariant: by multiplying $y_0 - w$, σ_0 and σ_S (and firing costs, if any) by the same constant, one should also verify the same firing hazards.

Only one of the scaling problems can be solved by normalization, which we do, by setting the wage to unity. Fortunately, the effect of introducing firing costs at three months tenure is known, or at least can be reasonably assumed to equal advance notice plus the FGTS fine for that tenure: $(1+50\%\times 0.08\times 3)w = 1.12$. Assuming that this is the only discontinuity in firing costs faced by the firm at that point, this provides another reference for scaling.

Further, the discussion of firing costs' effects implies that it is impossible to distinguish between a non-observable, constant firing cost and a increased y_0 by just observing the firing hazard. We address this problem by assuming free entry, which fixes the value of vacancy at zero, and considering that separation during experience period entails no costs. Thus separation value at experience period equals zero.

Finally, we note that, besides wages, two parameters contribute to the variation of effective firing costs for never inspected matches at T_H: the proportion of benefits evaded η and the correction rate $\tilde{r}$. We chose to fix $\tilde{r}$ and find the corresponding η. If we underestimate the correction rate, it is likely that the level of evasion is overestimated.

2.3.3
Some considerations on model assumptions

A key assumption of our model is that of constant wages during the employment contract. The main consequence of this assumption is to turn severance payments to the worker into an effective separation cost. With flexible wage, risk neutral agents “undo” legal severance payments effects (Lazear, 1990). In this case, separation decisions result from maximization of match total value (sum of worker's and firm's payoff), and any discontinuity in firing behavior should arise from variation in total separation cost. With risk adverse workers, agents would seek an “optimal contract”, prescribing some level (in general other than the legally provided) of severance payment (Pissarides, 2001). Even in this case, separation would depend on relationship's total surplus. With maximization of match surplus, the discontinuities we observe in RAIS data could only appear as result of pure firing costs such as administrative costs or payments to the government.

Although wages do actually vary during a job relationship, there are several restrictions which prevent it from adjusting in response to agents' information. One important legal prohibition is that of reducing nominal wages, as the firm would like to “charge” the worker for the raise in severance payment just before one year tenure. Furthermore, actual data show that there is not much variation in wages during the first year of tenure, which is the relevant time horizon for our analysis.

With respect to our model for non-compliance with labor regulations, it is worth noting that it is reasonable to assume that the workers value the non-wage benefits (as suggested by Almeida and Carneiro (2012)) and that they should anticipate the expected amount of benefits flow at bargaining, based on firm's characteristics and local inspection inputs. In such a setting the firm could benefit from committing to comply with regulations, instead of distorting its turnover behavior to avoid the distributive effect of homologation eligibility. Failure to commit, however, is likely to arise in an environment where there is little effort towards effective punishment, as inspection activity deliberately focus on guaranteeing future compliance instead.

2.4 Empirical method

2.4.1 Data

We use data from Relação Anual de Informações Sociais (RAIS) for the years 2008 to 2010 to estimate by maximum likelihood the parameters of our model. This is an administrative database, sent annually by firms to Labor Ministry and covering employment contracts that were active for at least part of the previous calendar year. Virtually all formal employment relationships in Brazil are covered, amounting to over 40 million observations in the recent years.

Each record represent a single employment contract and include information such as the hiring date, type of contract (open-ended CLT, temporary CLT, public employment, apprenticeship, etc.), whether/when it was terminated during the year and type of separation and hours worked. Since 2003, data include exact hiring and separation dates, allowing for exact calculation of job relationships' duration. Since 2008, the wage rate in minimum wages is available, allowing for the computation of UI replacement ratios. We classify the contracts according to whether the contractual wage is of up to two minimum wages or greater than that.

Firms are identified by their corporate identity numbers, allowing to determine their size (number of active employees) at any given time. Firm type and sector is also available. For our empirical exercise, we use size of the firms at the beginning of each year, obtained by looking at firms' size at the end of the previous year. We count the number of different employees working for the same employer and classify the firms in five categories: up to 9, 10 to

19, 20 to 49, 50 to 249, and 250 or more employees.

For the workers, there is information on gender, age, educational level and race. It is also possible to link the records for the same worker, as an identity number is provided.

Our sample is restricted to full time jobs (defined here by 30 or more hours per week) with CLT open-ended contracts between private sector, non-agricultural firms and workers with ages from 20 to 59 years.

In the empirical exercise, we use estimates of inspection probability from Chapter 1, which are available for years 2007 to 2010 and use many datasets besides RAIS. These estimates are calculated based on firms' size and sector of activity, and characteristics of the city where they are located, including distance – in hours by car – from the nearest city with a Labor Ministry's inspection office. Estimates are available for all cities except in Amazonas and ParÃ¡ states, which are then excluded from the sample.

		Avg wage (in m. w.)	UI repl ratio	Avg # inspection (per year)	% terminated		N
					layoffs	quits	
Total		2.24	77%	0.518	28.4%	9.0%	21,568,303
Subsamples by firm size and wage							
Up to 9	**< 2 mw**	1.32	86%	0.078	30.2%	8.7%	4,099,999
	> 2 mw	3.51	61%	0.076	27.0%	6.5%	848,879
10-19	**< 2 mw**	1.37	85%	0.150	31.1%	9.8%	2,108,875
	> 2 mw	3.76	59%	0.138	25.1%	6.3%	660,125
20-49	**< 2 mw**	1.38	85%	0.250	31.5%	10.2%	2,444,265
	> 2 mw	3.95	58%	0.231	25.4%	6.2%	951,399
50-249	**< 2 mw**	1.40	85%	0.562	30.3%	10.9%	3,176,340
	> 2 mw	4.41	56%	0.543	25.5%	5.8%	1,675,271
250+	**< 2 mw**	1.37	87%	1.241	26.1%	12.3%	3,344,563
	> 2 mw	4.91	53%	1.194	24.6%	4.8%	2,258,587

Table 2.1: Summary statistics. Source: RAIS 2008-2010

Table 2.1 shows summary statistics of some of the variables utilized, for the whole sample and sub-samples defined according to wage and firm size. Aggregate data show that approximately 30% of the contracts observed in a given year are terminated during that year by unjustified dismissal, and 9% by employees initiative. The average wage is 2.24 minimum wages, and UI replacement ratios are high, averaging 77%.

The statistics for sub-samples show that inspection frequency is much higher for large firms: while firms with less than 10 employees should expect to be inspected once every thirteen years, those with 250 or more employees receive in average more than one visit per year. Replacement ratios are even higher among low-wage earners, exceeding 85%, while for the remaining of the sample it ranges between 50% and 60%.

2.4.2
Maximum likelihood estimation

We consider half-month periods and assume that learning takes place during fifteen years, i.e. the firm receives $T^* = 360$ signals. This long horizon was chosen in order to ensure that a large portion of the uncertainty could be resolved.

After normalizing wages to 1, there are nine remaining parameters in this model: match quality mean y_0 and variance σ_0^2, signal variance σ_S^2, the amount of UI that is appropriated by the firm ΔS_{UI}, evasion η, the rate of growth of the labor liability $\tilde{r}$, economy's discount/interest rate r, and the rates of occurrence of inspections p and quits q . We fix $r = 0.0025$ (roughly 6% per year), $q = 0.004$ (9% per year) and $\tilde{r} = 0$ and use sample averages of the estimates for p from Chapter 1.

Observations consist of censored employment spells, which can be represented by $(t_i^A, t_i^B, \mathbb{1}_i^f)$, where t_i^A is the time the unit i enters the study – i.e. tenure at the beginning of the year –, t_i^B is the last time when it is observed – end of the year, or upon termination of the employment relationship –, and $\mathbb{1}_i^f$ is an indicator of whether the worker was fired at t_i^B.

The log-likelihood of observation $(t^A, t^B, \mathbb{1}^f)$ is:

$$L(t^A, t^B, \mathbb{1}^f; \theta) = \sum_{t=t^A}^{t^B-1} \log(1-h(t,\theta)) + \mathbb{1}^f log(h(t_B;\theta)) + (1-\mathbb{1}^f) log(1-h(t_B;\theta)) \tag{2-9}$$

where $\theta = (\sigma_0^2, \sigma_S^2, \Delta S_{UI}, \eta, y_0)$ and $h(t;\theta)$ is the firing hazard at time t obtained from the solution of the firm's problem, using parameter configuration θ.

As our focus is on phenomena that take place early at the employment relationship, we fit the likelihood on the first 18 months, by censoring all observations at period $t = 36$. Log-likelihood function is given by:

$$\mathcal{L}((t_i^A, t_i^B, \mathbb{1}_i^f)_{i=1}^N; \theta) = \sum_{i=1}^N L(t^A, t^B, \mathbb{1}^f; \theta) \tag{2-10}$$

The model is estimated, first, by assuming common parameters for the whole dataset. Next we divide our data in ten sub-samples according to firm size and wage rate. As we have seen in the previous subsection, firms with different sizes face very different enforcement levels. Wage rate, in turn, is related with replacement ratios and thus with the relative magnitude of UI benefits.

In order to account for the effects of other institutional details of the experience period and advance notice legislation, two adjustments were applied to the empirical hazards to yield a suitable target.

First, for tractability, we assume in our model that every firm has six periods where costs are zero, representing a 90-days experience contract. The empirical hazard, however, reflects a mixture of firms adopting different lengths of experience contract allowed by the law, the most common being two one-month or 45-days periods. Further, experience contract generates some indivisibility, as there is a penalty associated with early termination. Therefore, most of early separations are distributed between 30, 45, 60 and 90 days, according mainly to firms' experience period length choice, instead of learning parameters. Because of this, we choose to target cumulative hazard after three months instead of each point in this period. We implement this by treating the experience period as a single period (for likelihood calculation purposes).

The other issue that requires adjustment is that contract length includes the advance notice (even if the firm pays the corresponding wage and dismisses employee from working during the notice period). Therefore, except for terminations during the experience contract, reported tenure is approximately one month (or exactly 30 days) longer than the term between hiring and firing decision. This, in turn, implies that for employment relationships started as a 90-days experience contract, there would be no dismissals between 90 and 120 days. For this reason, we also aggregate hazards between 3.5 and 6 months.

A last difficulty worth mentioning is that of computing and maximizing the likelihood, which is addressed in Appendix A.

2.5 Results

The results of maximum likelihood estimation are presented in Table 2.2. The first column shows the estimates with respect to the whole sample. It is possible to verify that estimates for the whole sample are similar across years, so we pool the data for the entire period. The results indicate that uncertainty regarding match quality is very relevant, with the standard deviation of match quality being almost twice the wage rate. Further, the average match quality is lower than the wage, which implies that most of the matches are not profitable. This suggests that the difficulty in finding suitable matches should be a major driver of high turnover.

Signal standard deviation is about 12 times larger than the standard deviation of match quality. It follows from expression (2-3) that it takes 144 signal observations to resolve half of the uncertainty on match quality (i.e. to reduce beliefs' variance to half of the prior variance).

Estimated UI effect if 0.2 monthly wages. Recalling the average replacement ratio of 77% and three instalments, this corresponds to the firm receiving 8.7% of the UI benefit, if one considers the "separation rent sharing" story. This is also roughly matches the anecdotal evidence that in fake lay-offs the employee returns the firing fine. This amount varies between 20% and 40% of a monthly wage for tenures from half to one year, when many lay-offs take place.

Finally, it is found that discontinuity at one year tenure should be associated with almost 2% of the "full wage" being evaded. This implies, along with our assumptions on discount and correction rates, an accumulated labor liability balance close to 24% of a monthly wage after one year. Therefore homologation and UI eligibility generate distortions of similar magnitude.

The results for sub-samples allow to identify some patterns. First, firms appear to be more selective when hiring workers with higher wages, as the match quality has generally both a smaller variance and a higher average among jobs paying more than 2 minimum wages.

With respect to evasion, it is noted that η is higher for smaller firms and among low wage jobs. This is consistent with the fact that workers value the benefits, as in this case, compliance is a more important constraint when downward adjustment of wages are not possible (Almeida and Carneiro, 2012). It also suggests that compliance is more costly for small firms.

Finally, the effect of UI on firing is concentrated in jobs with low wages. For those, UI eligibility has the effect of a reduction in firing costs by 23% to 45% of the monthly wage. Among job with higher wages, the effect is less than 10% except in very small firms.

In Figure 2.5 we compare empirical hazard with the hazard calculated using our model and the fitted parameters. The model captures the most prominent features of firing hazard data.

Figure 2.6 illustrates the effects of sequentially eliminating the incentives in the institutional environment. First, we simulate full enforcement of labor regulations by considering that all matches start and remain at the compliant (inspected) state. This eliminates two distortions: the coexistence of matches with same productivity but treated differently by the firm, and avoidance of homologation. Next, we simulate the elimination of UI surplus sharing by setting $\Delta S_{UI} = 0$. Finally, we experiment setting $S_t = 0, \forall t = 1, 2, 3, \ldots$ thus eliminating the effect of firing costs, both the amount paid to the government

Parameter		Aggregate 2008-2010	Breakdown by firm size and wage									
			Up to 9 workers		10-19 workers		20-49 workers		50-249 workers		250+ workers	
			< 2 m.w.	> 2 m.w.	< 2 m.w.	> 2 m.w.	< 2 m.w.	> 2 m.w.	< 2 m.w.	> 2 m.w.	< 2 m.w.	> 2 m.w.
Quality mean	y_0	0.47	0.46	0.58	0.42	0.68	0.55	0.63	0.46	0.58	0.50	0.77
		0.0002	*0.0004*	*0.0007*	*0.0005*	*0.0006*	*0.0004*	*0.0005*	*0.0003*	*0.0005*	*0.0003*	*0.0007*
Quality s.d.	σ_0	1.94	2.01	1.86	2.14	1.55	1.38	2.09	1.93	1.93	2.01	1.11
		0.0003	*0.0009*	*0.0019*	*0.0010*	*0.0018*	*0.0008*	*0.0015*	*0.0007*	*0.0012*	*0.0008*	*0.0043*
Signal s.d.	σ_S	24.70	24.39	25.88	29.69	23.44	13.49	43.36	26.32	30.75	29.43	5.99
		0.0122	*0.0328*	*0.0742*	*0.0372*	*0.0743*	*0.0242*	*0.0736*	*0.0254*	*0.0511*	*0.0298*	*0.0164*
UI effect	ΔS_{UI}	0.20	0.45	0.23	0.36	0.03	0.23	-0.01	0.24	-0.02	0.35	0.08
		0.0013	*0.0023*	*0.0057*	*0.0035*	*0.0064*	*0.0029*	*0.0058*	*0.0029*	*0.0056*	*0.0025*	*0.0042*
Evasion	η	0.0193	0.0272	0.0108	0.0263	0.0051	0.0158	0.0056	0.0180	0.0035	0.0128	0.0066
		0.0003	*0.0004*	*0.0007*	*0.0006*	*0.0008*	*0.0005*	*0.0007*	*0.0007*	*0.0008*	*0.0011*	*0.0013*
N		21,568,303	4,099,999	848,879	2,108,875	660,125	2,444,265	951,399	3,176,340	1,675,271	3,344,563	2,258,587

Table 2.2: Estimates and standard errors.

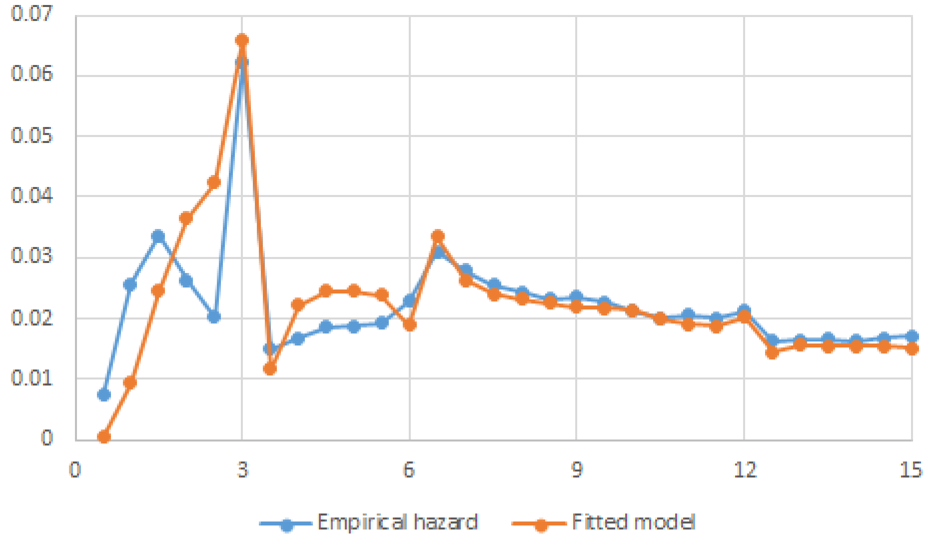


Figure 2.5: Empirical vs fitted firing hazard.

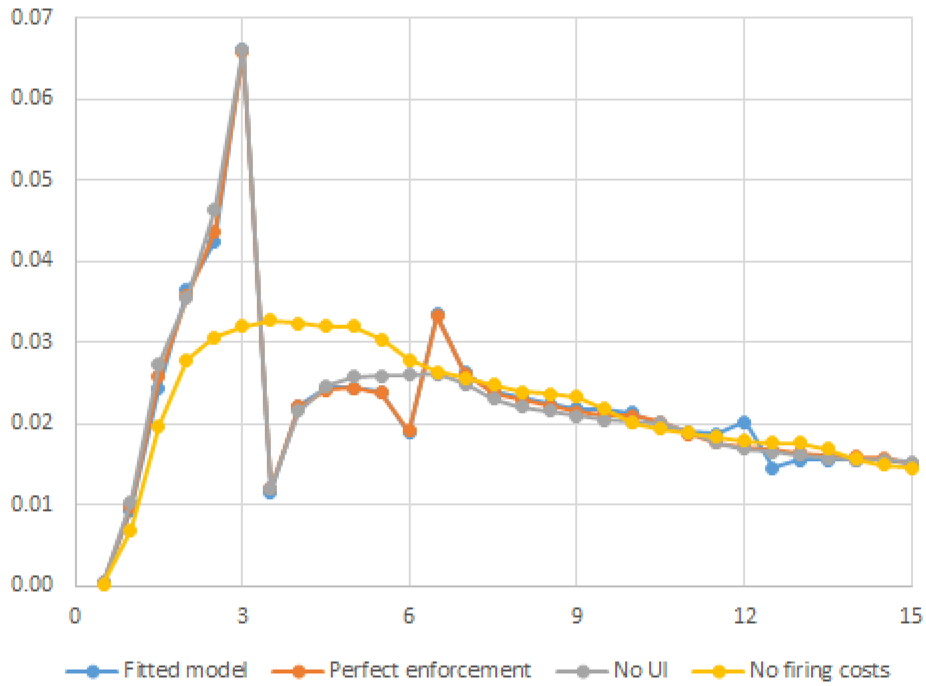


Figure 2.6: Firing hazard decomposition.

and the severance payments.

It can be noted that both UI and imperfect enforcement distortions produce sensible effects only locally, at short tenure intervals. Their effect on overall turnover and employment duration should thus be very limited. This suggests that the magnitude of the incentives generated are small compared to the selection of suitable matches. Elimination of firing costs, in turn, drastically reduces the number of lay-offs in the first three months and increases hazards in the next six.

2.6 Simulation

In the previous section, we have shown that learning and institutions are capable to explain a big part of firing hazard in Brazil. This suggests that incentives provided by regulations have sensible effects on firms' firing behavior. However, simulation of firing hazards under the three institutional changes described in the end of the last section suggest that the effects are concentrated on short periods, with firms delaying or anticipating few lay-offs by less than a month. In order to assess economic significance of those regulations, we now perform partial equilibrium simulations of the behavior of some outcomes of interest.

Firm size / wage groups		Fitted model	Expected employment duration Perfect enforcement	No UI surplus sharing	No firing costs
Up to 9	< 2 mw	39.91	-1.4%	-0.2%	+0.2%
	> 2 mw	42.37	-0.6%	-0.3%	-0.0%
10-19	< 2 mw	36.94	-0.8%	-0.5%	+0.6%
	> 2 mw	42.91	-0.2%	-0.0%	-0.1%
20-49	< 2 mw	37.17	-0.4%	-0.2%	+0.8%
	> 2 mw	40.92	-0.2%	+0.0%	+0.2%
50-249	< 2 mw	35.72	-0.2%	-0.4%	+1.0%
	> 2 mw	40.83	-0.0%	+0.0%	+0.0%
250+	< 2 mw	38.23	+0.0%	-0.4%	+0.4%
	> 2 mw	50.25	+0.0%	+0.0%	-0.5%

Table 2.3: Fitted model job duration and effect (% change) of policy simulations.

We begin by verifying the impact on overall turnover. Table 2.3 shows how employment duration would change in the alternative regimes. All effects are quite small. Full enforcement of labor legislation induces faster lay-offs, specially among small firms and lower-paying jobs, because it reduces profit flows. Removing UI benefits also decreases duration, but generally to a smaller extent. This reflects the postponing of a number of lay-offs that would otherwise happen before 6 months to just after this. Another conclusion is that distortion generated by UI do not directly promote turnover.

Finally, absence of firing costs would increase employment duration among workers earning less than 2 mw. Although of little magnitude, this effect is interesting as it highlights the fact that firing costs introduced only after a given tenure threshold do actually increase turnover in some cases. Recalling our discussion about the model, this happens because this type of firing costs reduce the expected value of every match, thus inducing higher turnover at low tenures, before being effectively charged.

Firm size / wage groups		Fitted model	Firm's profit			
			Perfect enforcement	No UI surplus sharing	No firing costs
Up to 9	< 2 mw	10.20	-3.2%	-1.8%	+5.8%
	> 2 mw	9.27	-1.4%	-1.0%	+6.3%
10-19	< 2 mw	8.14	-2.6%	-1.7%	+7.2%
	> 2 mw	7.25	-0.6%	-0.1%	+7.8%
20-49	< 2 mw	7.21	-1.3%	-1.2%	+7.8%
	> 2 mw	6.60	-0.5%	+0.1%	+8.5%
50-249	< 2 mw	6.94	-0.9%	-1.3%	+8.1%
	> 2 mw	7.80	-0.2%	+0.1%	+7.2%
250+	< 2 mw	7.80	-0.3%	-1.7%	+7.3%
	> 2 mw	15.52	-0.1%	-0.2%	+3.3%

Table 2.4: Fitted model expected profits and effect (% change) of policy simulations.

Next, we look at income flows. In Table 2.4 we simulate the expected present value of a match at $t = 0$ for the firm. As expected, perfect enforcement of benefits reduces firms' profits, with an stronger effect in firms and jobs with higher evasion level and lower incidence of inspection. Eliminating UI also reduces profits of low wage jobs and very small firms. Removing all firing costs, in turn, greatly improves jobs' values for all firm sizes and wage ranges.

Table 2.5 presents the impact of institutions on the income of a worker beginning at a job. It is shown that perfect enforcement has almost no effect on wages and benefits flows. This results from the offsetting of greater income flow due to reduced evasion by shorter tenures due to firms' reaction to increased costs. Removing UI surplus sharing has also negative – tough negligible – effects as we should expect since this both reduces duration a little. Elimination of firing costs has also a negative effect on workers' income. This shows that

Firm size / wage groups		Expected present value of wages and benefits			
		Fitted model	Perfect enforcement	No UI surplus sharing	No firing costs
Up to 9	< 2 mw	29.84	-0.1%	-0.0%	-1.3%
	> 2 mw	31.58	-0.1%	+0.0%	-1.5%
10-19	< 2 mw	28.06	-0.1%	-0.1%	-0.9%
	> 2 mw	32.14	-0.1%	-0.0%	-1.4%
20-49	< 2 mw	27.95	-0.0%	-0.2%	-0.7%
	> 2 mw	31.08	-0.0%	+0.0%	-1.2%
50-249	< 2 mw	27.34	+0.1%	-0.2%	-0.6%
	> 2 mw	30.78	+0.0%	+0.0%	-1.3%
250+	< 2 mw	29.18	+0.1%	-0.1%	-1.0%
	> 2 mw	35.27	+0.0%	+0.0%	-1.6%

Table 2.5: Fitted model expected wages and benefits and effect (% change) of policy simulations.

at least part of the increase in profits occur at expense of employees' lay-off compensation.

Results in Tables 2.4 and 2.5 are not immediately comparable, as profits and wages have different base levels. In order to assess the effects of policy on match income, we add match income of employers and employees. Results are presented in Table 2.6. Clearly, perfect enforcement and elimination of UI reduce match income, as they decrease both profits and workers' incomes. Eliminating firing costs, in turn, has positive effects in except for higher paying jobs at large firms.

Finally, in order to evaluate whether elimination of distortions enhances efficiency of turnover decision, we look at the match quality resulting from firms' turnover decisions. Table 2.7 describes effects of the different regimes on match quality. It shows that, although reducing distortions generally increase productivity, all of the studied changes have a insignificant impact – often less than 0.1% – on productivity of surviving matches. This was expected in relation to perfect enforcement and eliminating UI, given their small effect on overall turnover.

With respect to "no firing costs" scenario, we conclude that the gains observed are associated with better selection. By delaying some lay-offs (instead of concentrating them on experience period) firms reach the same overall match quality, but with less waste of good matches.

Firm size / wage groups		Fitted model	Match income Perfect enforcement	No UI surplus sharing	No firing costs
Up to 9	< 2 mw	40.04	-0.9%	-0.4%	+0.5%
	> 2 mw	40.85	-0.4%	-0.2%	+0.2%
10-19	< 2 mw	36.20	-0.7%	-0.5%	+0.9%
	> 2 mw	39.39	-0.2%	-0.0%	+0.3%
20-49	< 2 mw	35.17	-0.3%	-0.4%	+1.0%
	> 2 mw	37.68	-0.1%	+0.0%	+0.5%
50-249	< 2 mw	34.28	-0.1%	-0.4%	+1.1%
	> 2 mw	38.59	-0.0%	+0.0%	+0.4%
250+	< 2 mw	36.98	+0.0%	-0.5%	+0.7%
	> 2 mw	50.79	+0.0%	-0.0%	-0.1%

Table 2.6: Fitted model expected total match income and effect (% change) of policy simulations.

Firm size / wage groups		Fitted model	Average match quality Perfect enforcement	No UI surplus sharing	No firing costs
Up to 9	< 2 mw	1.57	+0.4%	+0.0%	+0.1%
	> 2 mw	1.50	+0.1%	+0.0%	+0.1%
10-19	< 2 mw	1.53	+0.2%	+0.1%	-0.0%
	> 2 mw	1.40	+0.0%	+0.0%	+0.1%
20-49	< 2 mw	1.44	+0.1%	+0.0%	+0.0%
	> 2 mw	1.41	+0.0%	-0.0%	+0.1%
50-249	< 2 mw	1.48	+0.0%	+0.1%	-0.0%
	> 2 mw	1.47	+0.0%	-0.0%	+0.1%
250+	< 2 mw	1.50	-0.0%	+0.1%	+0.0%
	> 2 mw	1.58	-0.0%	-0.0%	+0.2%

Table 2.7: Fitted model average match quality and effect (% change) of policy simulations.

2.7
Conclusion

In this paper, we describe incentives provided by Brazilian legislation for firms' firing decision. Besides firing costs directly implied legal restrictions and penalties for unjustified dismissals, we found that job security provisions and imperfect enforcement also have influence on labor turnover. The former may subsidize lay-offs, possibly because employers and employees share the surplus from dismissed workers' access to UI and to their balance of public severance payment fund. Imperfect enforcement, combined with the mandatory examination of separations at tenures longer than one year, induce early lay-offs by non-compliant firms in order to avoid detection. We analyzed administrative data from RAIS, which suggested that those effects indeed play a part in explaining the empirical firing hazard.

We proposed a model incorporating those institutions into a endogenous turnover framework based on learning about match quality. This model was shown to generate firing dynamics remarkably similar to that exhibited by actual data. Importantly, it allows for quantifying the effects of the institutions based on the response of firing hazards to their introduction.

By estimating the model using RAIS data, we found that distortions do contribute to explain the firing patterns, by having sensible impact on firing costs. Our estimates indicates that firing costs may reduce by up to 45% of a monthly wage when workers become entitled to receive the unemployment insurance benefit, and that discontinuity of firing hazard at one year is compatible with a evasion level close to 2% of the wage and benefits costs among small firms.

Simulation exercises, however, led to the conclusion that the effects of the studied institutions on outcomes of interest should have very limited economic significance. Firms' reactions to the distortions can be characterized as a fine adjustments in lay-off decisions in order to benefit from reduced firing costs.

Further, our results show that legal firing costs provide little disincentive to turnover, at least in short tenures. The response of most firms to firing costs imposed on open-ended formal contracts is to lay-off a large amount of workers at the end of the experience period allowed by legislation. Our findings suggest that this response reduce the income generated by matches by inducing the dissolution of profitable matches. However, this is not a conclusive argument against the design of Brazilian firing provisions, since our model does not recognize the insurance role of the severance payments.

In future work, we hope to include other responses of economic agents to those institutions, which may shed light on their indirect contribution to turnover.

Appendix A

There are two main computational difficulties faced when fitting the model. First, we need to approximate the match quality distribution through discretization, by truncating the real line at $y_0 \pm 4\sigma_0$ and dividing the resulting interval in 1601 bins with width equal to 0.5% of σ_0. This discretization of state space generates noise, which makes likelihood function discontinuous in its parameters.

Another problem found is that calculation of likelihood function is expensive, as it requires solution of firm's problem, which involves backward induction with hundreds of periods and different transition probabilities for each one. However, it is possible to make parallel calculations of L for many σ_0^2, ΔS_{UI}, η and y_0 and a fixed $\frac{\sigma_S^2}{\sigma_0^2}$ ratio (which imply identical transition probabilities).

We addressed the "discretization noise" by calculating log-likelihood with different partitions of the match quality space and taking an average of the results. We have varied the center of the bin containing y_0 in the set

$$\{y_0 - 0.5\%\sigma_0, y_0 - 0.49\%\sigma_0, y_0 - 0.48\%\sigma_0, \ldots, y_0 + 0.5\%\sigma_0\}$$

This procedure yielded a smoother objective function for numerical optimization.

We compute the standard errors using the hessian of $\mathcal{L}$. Again due to "discretization noise", we calculate the latter by fitting a least-squares quadratic approximation for the likelihood function in a grid of points near the estimates, with y_0, σ_0 and σ_S ranging from 99% to 101% of their estimates, and ΔS_{UI} and η varying by ± 0.1 and ± 0.01 respectively.

3
Unemployment Insurance and investment in employment relations

3.1
Introduction

Along with the severance payment accounts scheme (FGTS), the Brazilian unemployment insurance (UI) program is often cited as a major incentive to high turnover and reduced investment in employment relationships by workers and firms (Gonzaga, 1998; Barros et al., 2000). The argument is that, on one hand, these benefits generate separation rents to the employees, which thus have incentives to induce their own lay-off. On the other hand, as most of the firing costs paid by the firm are directly received by the worker, it is possible that both parties collude to share the separation rents. This observation raises the concern that the opportunity of realizing such short term profits may preclude the investment in productive relationships.

As we have seen in the previous chapters, most of the lay-offs occur before the employment relationship completes one year, when accumulated FGTS balance amounts to less than one monthly wage. UI replacement ratios, however, are relatively high in Brazil with an average replacement ratio greater than 80% among employees earning up to two minimum wages. Further, workers become eligible for a three months benefit once they complete six months of tenure. Therefore, UI may represent an important share of income generated by short duration jobs, and thus provide incentive for a high turnover behavior. An important feature of the legal mechanisms generating the separation rents is that it depends on the separation being initiated by the firm. Thus, the collusion between the firm and the worker takes the form of staging a "fake lay-off", namely, to label the separation a "firing without" cause although initiated by the worker. Typically, such an arrangement involves the worker returning the mandatory severance payment to the firm, and possibly compensating the latter for the (relatively small) fine paid to the government.

In this chapter, we propose a model that attempts to capture this effect and quantify its importance. As in Chapter 2, we model firms' turnover behavior as the result of learning about match quality. The present model, however, emphasizes the value of the investment in the employment relationship, a key point of the argument that the Brazilian turnover rates are excessive and harmful to productivity. This dimension is introduced by making the match productivity dependent on a relationship specific investment by the worker, instead of assuming an exogenous match quality considered before.

In this environment some workers will choose to invest in their current job increasing its productivity. Due to match heterogeneity – modeled through a random cost of investing, observed only by the worker when the match is formed – , however, some employees will prefer to not invest. Given the firm's imperfect information on productivity, these workers may continue at the low productivity match while trying to find another job. Our model shows how the possibility of staging a fake lay-off may work as a subsidy to this strategy, thus reducing incentives for the accumulation of relationship specific capital. Similarly, if the UI mostly benefits the non-investing workers , because they should expect to receive it earlier, it may also have the same perverse effect.

Our model resembles the one proposed by Moscarini (2005) in that it incorporates exogenous shocks which may cause separations for other reasons than learning. This structure allows us to derive an equilibrium ergodic distribution of workers' productivity and employment states. The effect of incentives on outcomes of interest can then be assessed by their effect on the equilibrium distribution of workers across different states.

We calibrate the model using only firing hazard data from RAIS, known firing costs and UI replacement ratios, and verify that it generates plausible behavior for some observable quantities. Essentially, knowledge of some firing costs faced by firms help to pin down the rewards from good matches and costs from bad ones. We associate the volume of separations generated by fake-layoffs with the increase of hazard function at six months, which we consider to be reflective of the relabeling of quits due to the increased lay-off subsidy generated by eligibility for receiving the UI benefit.

Finally, we use the calibrated model to simulate the effects of alternative institutional settings. Our simulations suggest that the fake layoffs should have limited effect on the incentives for investing. The UI benefit scheme in place until recently, in turn, is shown to provide an important incentive to high turnover/low productivity behavior. We find that eliminating UI completely would lead to a 30% increase in the probability of investment by the worker, inducing increases of 26% in expected job duration and 4% in economy productivity. The numerical analysis further shows that a relatively high eligibility threshold – such as currently being implemented in Brazil –

can turn the UI into a positive incentive to investment in labor relationships. A two-year tenure threshold, for instance, is shown to promote even more investment than elimination of the benefit. An important limitation of the present analysis is that the response of the workers is assessed through the extrapolation of a parametric model, specially regarding the costs of investing in the job. Since we rely on the observation of local behavior – e.g., there is no variation of institutional setting during the period for which data is available –, our estimate of this component should be deemed tentative. Nonetheless our results illustrates that the effect captured by our model may be of substantial importance.

The model proposed in this chapter highlights the relationship between unemployment benefits, incentives for investment in job-specific human capital by workers, and turnover. To the best of our knowledge, this standpoint has not been explored yet in the literature. Indeed, most of the papers on UI benefits have focused on their impact on job search. The main strand of this literature studies the relative importance of the insurance role and the moral hazard cost of UI systems (e.g., the methodological contributions of Baily (1978); Chetty (2008); and the empirical analysis of Brazilian UI: Hijzen (2011); Gerard and Gonzaga (2013)).

Less attention has been directed to the study of the effects of UI on separation behavior (Rebollo-Sanz, 2012; Rebollo-Sanz and García-Pérez, 2014), which have offered two theoretical explanations. One of them suggests that the benefits generate incentives to lay-offs. Feldstein (1976) highlight the fact that, in absence of perfect experience rating[1], the firms can take advantage from the UI system by offering "employment packages" that include temporary separations in periods of low demand. For those periods, dismissed employees receive UI benefits, but have an implicit agreement to be hired back by the same firm. If the firms do not fully pay for the burden they impose on the UI system, there is a fiscal externality that favors firms with high turnover. Cahuc and Malherbet (2004) further show that UI may cause the firms to fire excessively both due to the fiscal externality and because it increases reservation wages. They find that by imposing a suitable level of experience rating, it is possible to reduce turnover and increase equilibrium employment and welfare.

Another strand of literature on UI and separations, represented by the works of Baker and Rea (1998); Lemieux (2000), deals with the labor supply response to UI eligibility rules. This literature has focused on the extensive margin of the supply, it considering the effect of UI in a context where workers

[1]Experience rating is a method of calculation for an insurance premium that considers the history of claims. In the case of UI, such a method should prescribe that firms must contribute to the UI system proportionately to the benefits received by the workers it fires.

choose to alternate periods of labor market participation and periods receiving benefits. Those studies draw on the idea that the worker should optimally use the UI system by working in order to reach a certain eligibility threshold and then becoming unemployed until exhausting the benefit. By observing policy changes in Canadian UI, Baker and Rea (1998) show sizeable effects of eligibility on separation hazards. Lemieux (2000) studies the effect of exposure to the system and finds that after a first unemployment spell, individuals have increased propensity to exploit the UI design. Our model contributes to this literature by addressing a further possible link between UI and turnover that operates through another supply-side effect, namely the effort choice of employed workers.

We find effects closer to the one described in the literature relating employment protection legislation and productivity (Suedekum and Ruehmann, 2003; Belot et al., 2007). Indeed, those works study precisely the same channel for productivity as we do, namely, the incentives for the worker to make a costly relationship-specific investment. Belot et al. (2007) observe that there appears to be an inverted U-shaped relationship between employment protection and economic growth. They propose that some positive level of employment protection can stimulate growth because they ensure that the workers will be rewarded for acquiring job-specific skills. In the same context, Suedekum and Ruehmann (2003) identify two opposing effects of employment protection. They find, on one hand, that severance payments promote investment by increasing the expected amount of the match rent appropriated by the worker. On the other hand, they observe that there is a competing "lethargy effect", which is characterized by reduced motivation to invest due to mitigation of the cost of a job loss by the severance payment. This latter effect is similar to the "perverse incentives" we address. The rest of this chapter is organized as follows. In the next section we present our model. Next, in section 3.3 we describe our calibration and simulation procedures. The results are presented and discussed in section 3.4. Concluding remarks are made in section 3.5.

3.2 The model

3.2.1 Basic setup

We model the employment relationship in the formal sector as an production activity whose productivity y depends on an investment in specific human capital by the worker. If the investment, denote by I, is not made ($I = 0$) the productivity is y_0 per period (we will thus call this a low quality match), which we assume that coincides with the worker's opportunity cost of participation in the formal market (e.g. his or her productivity/wage in a competitive informal market). If the worker chooses to invest ($I = 1$), match productivity is $y_1 = y_0 + \alpha$ per period (high quality match). Both the worker and the firm seek to maximize their own net income flow, and have common discount rate δ.

After meeting, the worker and the firm set wage rate by Nash bargaining. Next, the worker observes the investment cost for the current job C and decides whether to make the investment. Investment decision can be interpreted as a costly effort to acquire job-specific skills. We assume that this cost is spent before production takes place and thus becomes a sunk cost for the worker.

The firm does not observe whether a match is of low or high-quality, but every period, it receives a signal about this. Each signal is normally distributed with variance σ_S^2 and mean -1 or $+1$, respectively if $I = 0$ or $I = 1$, so that a positive (negative) signal is an evidence for $I = 1$ ($I = 0$). The signal is stronger the greater its absolute value is. Initially, the firm holds the prior belief that p_H of the matches will turn out to be of high quality. At the end of each period, the firm updates its beliefs on the productivity of the current match and must choose whether to continue it or to separate.

While the match is not terminated, the firm earns a profit flow of $y_I - w$ per period (but does not observe it until the match is terminated), where w is the wage rate. When the firm chooses to separate, it must pay firing costs.

Firing costs are positive for tenures longer than three months, comprising a one-month advance notice and the fine corresponding to 50% of FGTS balance and is applicable after the experience period. The FGTS balance amounts to 8% of accumulated wages, thus the firing fine corresponds to 4% of a monthly wage per tenure month, and we consider that advance notice costs one full monthly wage (productivity is zero during notice period). In summary:

$$FC_t = \mathbb{1}(m(t) > 3) \times (1 + 0.04m(t))w_{mo}$$

where: $\mathbb{1}$ is the indicator function; $m(t)$ is the equivalent of t in months; and w_{mo} is the monthly wage. The worker, in turn, receives a severance payment equal to the advance notice plus 40% of the FGTS balance SP_t and, for tenures greater than six months, the UI benefits UI_t:

$$\begin{aligned} SP_t &= \mathbb{1}(m(t) > 3) \times (1 + 0.032m(t))w_{mo} \\ UI_t &= \mathbb{1}(m(t) > 6) \times (\delta_{mo} + \delta_{mo}^2 + \delta_{mo}^3 + \mathbb{1}(m(t) > 12)\delta_{mo}^4)\rho w_{mo} \end{aligned}$$

where ρ is the replacement ratio and δ_{mo} the monthly discount factor.

Besides the firm's turnover strategy, two types of shock may trigger a separation. First, every period a fraction θ of the matches are hit by a "technological shock" ($\theta-$shock), which is readily observed by the firm, and become unproductive. In this case, the firm should lay-off the worker.

Second, every worker, both the employed and the unemployed, has a probability λ of receiving a "labor market shock" ($\lambda-$shock). When this happens, some firms, including the current employer, observe the worker's productivity. Then, the worker has the opportunity to renegotiate the wage rate, to quit or to propose a fake lay-off to the firm.

The $\lambda-$shock reflects an improvement in the labor market conditions experienced by the worker. When there are good alternative job opportunities, the worker who chose $I = 0$ has an increased incentive to quit or to propose a fake lay-off. We assume that a fake lay-off is possible only when the worker is eligible to receive the UI. Non-eligible workers must choose to quit or continue at the current job. Further, for simplicity, we consider that, in case of fake lay-off, the dismissed employee is allowed to begin at the new job after receiving all UI installments, and that he or she fully returns the firm's firing costs. Finally, we consider that this shock is also observed by the firm (and so it may infer that $I = 1$ if in equilibrium quitting/proposing a fake lay-off is profitable if and only if $I = 0$).

Both $\lambda-$ and $\theta-$shocks are observed at the end of each period, but before the firm and the worker make their separation decisions. Figure 3.1 presents the timeline of the model.

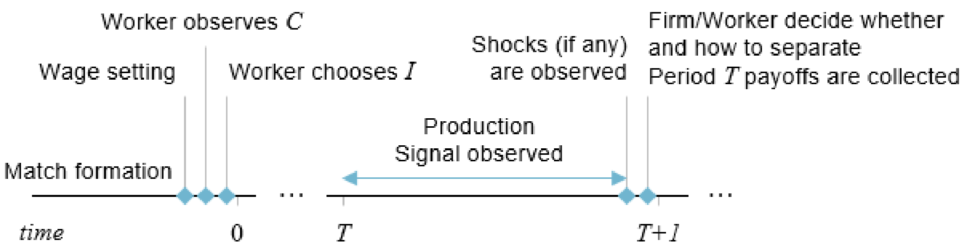


Figure 3.1: Model timeline.

3.2.2
Outline of the agents' behavior

Before describing the equilibrium, it is useful to outline the expected behavior of the workers and firms, specially their responses to the $\lambda-$ and $\theta-$shocks. We will focus on a particular type of equilibrium, which is compatible with empirically observed behavior. It can be verified that, with the calibrated parameter configuration presented in this paper, the model just described has an equilibrium of this type, and so do the alternative policy scenarios simulated later.

First, we focus on an equilibrium with $w > y_0$. This is reasonable as, otherwise, workers would receive less than their opportunity cost (recalling that y_0 is the wage rate outside formal labor market) by keeping a formal job. In principle, equilibria with $w < y_0$ would be possible: workers could eventually benefit from negotiating a wage increase (if $I = 1$) when a $\lambda-$shock arrives, or from the separation rent. However this would mean that either (i) workers experiment short term losses when moving to a formal job, which is inconsistent with the wage differences in formal and informal job markets, or (ii) that formal jobs are less productive than alternative occupations and only exist because are subsidized by the UI system, a scenario we deem unrealistic.

Further, we make the following assumptions about the mobility behavior of the worker: (a) unless a $\lambda-$shock occurs, the worker would ever prefer that the firm continues the job; and (b) when the shock occurs, the worker benefits from changing jobs if and only if $I = 0$, regardless of being eligible for receiving UI.

Clearly, condition (a) may hold only as an approximation, since with a sufficiently large severance payment, the worker would eventually benefit from being fired. However, we expect that when this happens, the number of surviving low quality matches should be very small. Underlying both conditions (a) and (b) is the fact that the "unemployed" (i.e., outside formal labor market) state has a substantially lower expected income than being in a match.

Under the assumptions above, the firm seeks, as it learns about the match, to separate from low quality matches while keeping high quality ones. Workers, in turn, will invest in jobs if and only if the cost C lies below a certain value. Workers facing a high C will not invest but will benefit from staying at the a low quality match, receiving a wage greater than their outside option, until they are fired or find an opportunity to move directly to another job. We assume that if the job change occurs when the worker is eligible for the UI, it will trigger a fake-layoff; otherwise there is a quit. This is consistent with the more efficient way to label a separation when collusion between the firm and the worker is costless. If UI is available, it is generally greater than the penalty paid by the firm to the government [2], and thus the match has a net rent to share. If the worker is not eligible the only transference generated by a lay-off is the firing penalty.

[2]UI is paid at least for three months, with an average replacement ratio (ratio of benefit to wage) of 77%, while FGTS fine for firing is 10% of a monthly wage per tenure year.

When the worker invests in the job, he or she expects. Further, unless bad signals lead the firm to make an inefficient lay-off or the match is dissolved by a technological shock, the state of the high productivity match is eventually revealed (by a $\lambda-$shock), triggering a renegotiation of the wage. Assuming this is made by Nash bargaining, the wage should raise to $y_0 + \gamma\alpha$, recalling that the investment cost paid by the worker is sunk and that the threat points of the parties are the respective "quit" payoffs, since the worker cannot force the firm to fire him.

The possible transitions the worker may experiment in any given period are summarized in Figure 3.2.

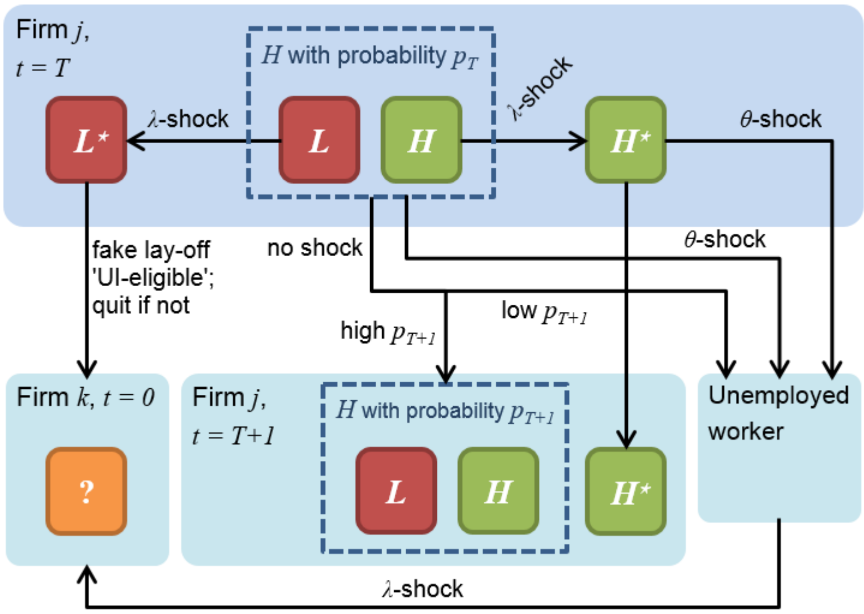


Figure 3.2: Possible transitions.

In the present model, the "perverse incentives" in Brazilian employment protection provisions are characterized by the subsidy to transitions between jobs, through fake lay-offs, and to high turnover behavior (investing only at very low C), through UI functioning in general. It is worth noting that, once the worker has taken the decision of not investing, the increased mobility has actually a positive impact on productivity, since it would increase the number of transitions to out of the low-productivity state to a new job in which the worker can be more productive. Thus the adverse effect works through the reflex of the turnover subsidy on employees investment.

The labor market shock considered here is of an extreme type for the sake of tractability. It represents a situation in which the worker has a guaranteed new employment after receiving all installments of UI benefits. More generally, we propose that fake lay-offs should correspond to voluntary separations initiated by workers who face an improvement in their outside option. Therefore, a more realistic model could consider a continuous characterization of the outside option of the worker, like the probability of finding a job after enjoying the separation rent. In this case, larger turnover subsidy would increase both the value and the frequency of fake lay-offs.

3.2.3
Value functions and equilibrium

Given the responses to shocks just outlined, there are two decision problems left to be examined. By backward induction, we defer the analysis of the worker investment decision and first consider the firm problem. As in Chapter 2, this is essentially consists in screening out bad matches when the productivity signals indicate a low probability of a good match ($I = 1$). The firm's learning process described above can be simplified as follows. Considering a prior belief with probability of $I = 1$ by p and a signal ξ, updating by Bayes' rule yields:

$$P(I = 1|\xi; p) = \frac{1}{1 + \frac{1-p}{p} e^{-\frac{2\xi}{\sigma_S^2}}}$$

which can be rearranged as

$$\log \frac{p}{1-p} = \log \frac{p}{1-p} + \frac{2}{\sigma_S^2}\xi$$

Therefore, let p_{t-1} be the belief at the beginning of period t and ξ_t the signal observed in this period, then beliefs' dynamics may be described as follows:

$$\log \frac{p_t}{1-p_t} = \log \frac{p_{t-1}}{1-p_{t-1}} + \frac{2}{\sigma_S^2}\xi_t \tag{3-1}$$

We conclude that (p_{t-1}, t) fully describes the state of firm's problem while the employee has not faced a labor market shock. Including t is necessary because of time-varying firing costs.

The value function for the firm is then given by:

$$\begin{aligned}\Pi(p_t, t) = \max\{ \;& p_t y_1 + (1-p_t)y_0 - w + \delta\theta(-FC_{t+1}) + \\ & +\delta\lambda p_t \overline{\Pi} + \delta(1-\theta-\lambda)E[\Pi(p_{t+1}, t+1)|p_t], -FC_t \}\end{aligned} \tag{3-2}$$

where $\overline{\Pi} = (1-\gamma)\frac{\alpha}{1-\delta(1-\theta)}$ is the profit appropriated by the firm in case of renegotiation with an investing worker. The expected profit from continuing the match can be decomposed in the expected profit flow $(p_t y_1 + (1-p_t)y_0 - w)$ and the continuation values in case of (i) $\theta-$shock (when the firm just fires the worker, paying FC_{t+1} at the beginning of the next period), (ii) $\lambda-$shock (renegotiates with investing workers, getting $\overline{\Pi}$; non-investing ones either quit or agree with fake lay-off, both cases resulting in a zero-cost separation) or (iii) no shock.

We note that, eventually the firing costs become sufficiently high so that the firm should never fire a worker. The problem can then be solved by a finite number of steps by backward induction. The solution to the firm's problem can be represented by a series of reservation values $(p_t^\star)_t$, such that the firm should lay-off the worker if $p_t < p_t^\star$.

Given this solution, and the outcomes of the shocks previously discussed, we now turn to the worker investment choice. The expected income flows of the worker for $I = 0$, $W_L(0)$, and for $I = 1$ with investment cost C, $W_H(0, C)$, can be fully determined.

Let the random variable τ be defined as the first time period for which p_t falls below $p_t^\star$. Then:

$$
\begin{aligned}
W_L(0) = E\Bigg[\sum_{t=0}^{\tau} (\delta(1-\theta-\lambda))^t \big(& w - y_0 + \theta\delta(UI_t + SP_t + W_U) + \\
& + \lambda\delta(\mathbb{1}(m(t) > 6) FL_t + W(0)) \big) \\
+ (\delta(1-\theta-\lambda))^\tau (UI_t + FC_t + W_U) & \qquad |I = 0 \Bigg]
\end{aligned}
$$

where $FL_t = UI_t + SP_t - FC_t$ is the rent obtained in a fake lay-off and

$$
\begin{aligned}
W_H(0, C) = E\Bigg[\sum_{t=0}^{\tau} (\delta(1-\theta-\lambda))^t \big(& w - y_0 + \lambda\delta\overline{W} + \\
& + \theta\delta(UI_t + SP_t + W_U) \big) \\
+ (\delta(1-\theta-\lambda))^\tau (UI_t + FC_t + W_U) & \qquad |I = 1 \Bigg] - C
\end{aligned}
$$

where $\overline{W} = \gamma \frac{\alpha}{1-\delta(1-\theta)}$ is the income appropriated by the worker in a high quality match when the wage is renegotiated. For ease of calculations, it is convenient to normalize the worker's income flows by subtracting the opportunity cost y_0 in every state.

The worker's expected pay-off at the beginning of a new job, before the investment cost is revealed is then given by:

$$
W(0) = E[\max\{W_L(0), W_H(0, C)\}]
$$

Workers outside a formal job, in turn, have normalized income flow of zero and face a probability λ per period of becoming employed. Thus, present value of this state is simply given by $W_U = \frac{\lambda}{1-\lambda(1-\delta)} W(0)$. Substituting this expression for W_U in the expressions for $W_L(0)$ and $W_H(0, C)$ above, one can write:

$$\begin{aligned} W_L(0) &= \omega_{a,L} + \omega_{b,L} W(0) & \text{(3-3)} \\ W_H(0, C) &= \omega_{a,H} + \omega_{b,H} W(0) - C & \text{(3-4)} \end{aligned}$$

where $\omega_{a,L}$, $\omega_{b,L}$, $\omega_{a,H}$ and $\omega_{b,H}$, are functions of the firm's problem's parameters and solution. The expected income flows from wages and separation benefits are captured by $\omega_{a,L}$ and $\omega_{a,H}$, while $\omega_{b,L}$ and $\omega_{b,H}$ represent a discount factor for the average time until the worker eventually moves to another job. Consistently with this interpretation, it is possible to show that $\omega_{b,L}$ and $\omega_{b,H}$ are both less than unity and $\omega_{b,L} > \omega_{b,H}$.

We further note that, if $C^\star$ is the value of investment cost that makes the worker indifferent between investing or not,

$$W(0) = W_L(0) + p_H E[C^\star - C | C \le C^\star]$$

Now, we assume that the worker's investment cost C is drawn from a uniform distribution over the range $[0, \overline{C}]$. Therefore, the equation above specializes to

$$W(0) = W_L(0) + p_H (C^\star)/2 \tag{3-5}$$

Finally, as by definition $W_H(0, C^\star) = W_L$, equations (3-3) to (3-5) define a linear system in $(W(0), W_L(0), C^\star)$, given p_H. Solving it yields

$$C^\star = \frac{(\omega_{a,H} - \omega_{a,L}) - (\omega_{b,L} - \omega_{b,H}) \dfrac{\omega_{a,L}}{1 - \omega_{b,L}}}{1 + \dfrac{p_H(\omega_{b,L} - \omega_{b,H})}{2(1 - \omega_{b,L})}} \tag{3-6}$$

Recalling that $p_H = \frac{\overline{C}}{C^\star}$, this relation can be used to test whether a set of parameters and prior belief can be rationalized by some value of $\overline{C}$ (denominator has to be positive). Further, in affirmative case, the relation shows what should be this value, a fact that we explore in our calibration exercise.

Finally, we have assumed that the wages are set by bargaining at the beginning of the relationship in such a way that the worker captures a share γ of the match pay-off. In summary, we define the equilibrium by $(w, p_H, (p_t^\star)_t, C^\star)$ such that: (i) $(p_t^\star)_t$ solves (3-2); (ii) $p_H = P(C < C^\star)$; and (iii) $W(0) = \gamma(W(0) + \Pi(p_H, 0))$.

3.2.4 Labor productivity

The economy's average labor productivity level is simply given by the shares of workers that are employed and have chosen $I = 1$ – whose productivity is $y_0 + \alpha$ – and that are unemployed or employed but have chosen $I = 0$ – whose productivity is y_0:

$$y = y_0 S_L + (y_0 + \alpha) S_H = y_0 + \alpha S_H \tag{3-7}$$

where S_L and S_H are respectively the shares of workers with low and high productivity.

Lets denote by U_T the proportion of workers outside the formal labor market at a given period T, by L_T^t the number of low productivity employed workers with tenure t, by H_T^t the number of "non-revealed‘" high productivity workers (i.e., those who were not hit by a $\lambda-$shock) with tenure t and by $H_T^\star$ the number of workers with high productivity already revealed.

Let D_L and D_H denote respectively the duration of a low productivity and of a non-revealed high productivity match, i.e., the number of periods until it is terminated or revealed by a $\lambda-$shock.

If every period a constant number of workers start at a new job and choose $I = 0$, then the number of low quality matches with tenure level t, L_T^t, will be constant in time (T) and proportional to the survival function for low quality matches, $S(t) = P[D_L \geq t]$. Further, a fraction $E[D_L]^{-1}$ of the low quality matches are separated. Of these, λ are separations originated by workers moving directly to another job (some quitting and others proposing fake lay-offs), which can be further decomposed in λp_H moving to high quality matches and $\lambda(1-p_H)$ to new low quality matches. The remaining $E[D_L]^{-1}-\lambda$ result from lay-offs by the firm due to bad signals.

Analogously for the number of workers in non-revealed high productivity matches, a fraction $E[D_H]^{-1}$ change states each period. Of those, λ become revealed, while the remaining $E[D_H]^{-1} - \lambda$ are fired.

Then, the vector $(U_T, L_T, H_T, H_T^\star)$ follow a Markov chain with transition matrix

$$\mathcal{M} = \begin{pmatrix} 1-\lambda & \lambda(1-p_H) & \lambda p_H & 0 \\ E[D_L]^{-1}-\lambda & 1-E[D_L]^{-1}+\lambda(1-p_H) & \lambda p_H & 0 \\ E[D_H]^{-1}-\lambda & 0 & 1-E[D_H]^{-1} & \lambda \\ \theta & 0 & 0 & 1-\theta \end{pmatrix}$$

Clearly, it is a irreducible, aperiodic Markov chain, thus it has a unique stationary distribution $v = (U, L, H, H^\star) = v'\mathcal{M}$. The last equation in the system $v = v'\mathcal{M}$ and the sum of the first with the second equations can be respectively rewritten as:

$$\begin{aligned} H^\star &= \frac{\lambda}{\theta} H \\ U + L &= \frac{E[D_H]^{-1} H + \theta H^\star}{\lambda p_H} \end{aligned}$$

Noting that $U + L = 1 - (H + H^\star)$, the two equations above can be solved for H and $H^\star$. Substituting in (3-7) yields:

$$y = y_0 + \alpha \left(\frac{\lambda p_H}{\lambda p_H + \theta \frac{E[D_H]^{-1}}{\theta + \lambda}} \right) \tag{3-8}$$

The relation above can be interpreted by noting that the quantity inside the parentheses is the proportion of the probability of a low productivity worker moving to a high quality match to the total of productivity transitions. It increases with the proportion of matches that turn out to be of high productivity p_H and decrease with the rate of separation of these matches $E[D_H]^{-1}$.

3.3 Quantitative analysis

3.3.1 Data

The data used in our calibration exercise is the empirical firing hazard and average replacement ratio from the Relação Anual de Informações Sociais (RAIS) for the years 2008 to 2010, described in Chapter 2. We consider the tenure of open-ended contracts between formal full time workers and private, non-agricultural firms.

3.3.2 Calibration of parameters

The model discussed in the previous section is determined up to nine parameters: the basic productivity y_0; the increase in productivity by investing α; the UI replacement ratio; the discount factor δ; the worker's bargain power γ; the maximum investment cost $\overline{C}$; the variance of the signals σ_S^2; and the rates of arrival of the technological and labor market shocks, θ and λ.

We consider half-month periods and normalize the productivity in absence of investment, y_0, to unity. For calculating the value of UI benefits, we take average replacement ratio among labor contracts from RAIS 2008-2010, which is 77%. Technological shock rate is fixed in 0.7% per period, which roughly matches the average empirical firing hazard at long tenures (5 to 7 years), where this exogenous effect should dominate. Finally we consider symmetric bargain ($\gamma = 0.5$) and set the discount rate as 0.65% per period ($\delta = 0.9935$), approximately 15% per year.

Next, we note that the firm's problem is determined by the equilibrium wage and investment probability and the parameters α, σ_S^2 and λ. Further, given the solution of firm's problem, one can compute W_L and $W_H(C)$ and choose $\overline{C}$ in order to meet equilibrium condition (3-5), ensuring consistence between the worker's investment choice and the chosen p_H. This suggests the following procedure:

1. Choose $(\alpha, \sigma_S^2, \lambda, p_H)$.

2. Compute the solution of the firm's problem for $(\alpha, \sigma_S^2, \lambda, p_H)$ and a grid of values for w (ranging between y_0 and y_1).

3. For each solution, compute the suitable $\overline{C}$.

4. Compute the pay-offs and select the solution with the least distance between γ and the worker's share of the match pay-off[3].

5. Calculate the likelihood of the empirical firing hazard data, in the same fashion as the estimation of Chapter 2.

This allows us to choose $(\alpha, \sigma_S^2, \lambda, p_H)$ by maximum likelihood estimation using empirical firing hazard data, and $\overline{C}$ by imposing (3-5).

It is worth noting that the dynamics of separations is rich enough to allow for the identification of the vector $(\alpha, \sigma_S^2, \lambda, p_H)$. First, we observe that p_H is more strongly related with the overall endogenous job destruction, as it determines the proportion of the matches the firm would like to terminate.

The speed at which the firm is able to distinguish good from bad matches is controlled by σ_S^2. This parameter is thus mainly associated to the dispersion of the lay-offs across the tenure range.

The parameter α, in turn, is pinned down by the size of the discontinuity in the firing hazard at the end of experience period. If α is small when compared to y_0, it will also be small relatively to w and thus the rewards $y_0 + \alpha - w$ from the good matches and costs $y_0 - w$ of the bad ones will be relatively small when compared to the firing costs.

Finally, identification of λ rests on our assumption that before eligibility for receiving UI the labor market shock results in quits, whereas after that

[3]This choice is likely to be well-defined as the share is increasing in w except near the extreme values

it results in fake lay-offs. Thus, at 6 months tenure, the level of firing hazard should increase proportionally to λ and to the share of surviving low quality matches.

3.3.3 Simulation exercises

We use the model with calibrated parameters to simulate four alternative policies. Our primary interest is on the impact of the institutional environment on the productivity and duration of employment spells.

First, we analyze the effects of fake layoffs by assuming that a worker in a match with $I = 0$, when hit by the $\lambda-$shock, must quit. This should clearly change the incentives in favor of $I = 1$ by the worker, since only non-investing workers have their pay-offs directly reduced. Further, in equilibrium we should expect an increase in w both because of the need to compensate workers for the reduced expected income and because of the increased productivity.

Next, we examine the consequences of eliminating entirely the UI benefits. This change would further reduce the worker's expected income in low productivity matches. Although workers in high quality matches would also eventually receive the UI, one should expect that the benefit has a lower impact than on the non-investing workers, since the latter tend to become unemployed earlier.

Finally, we consider two variations in the tenure required for UI eligibility. When the eligibility threshold increases, the pay-off of not investing is proportionately more impacted than that of investing. Thus, we should intuitively expect a change in the same direction as the previous policies considered.

3.4 Results

The results of the calibration procedure discussed in the previous section are reported in Table 3.1. They indicate that investment by the worker raises the match productivity by more than 80%, which, considering the discount rate δ and productivity shock θ, could increase the expected present value of income flows by more than 30 (considering as unit the base monthly productivity y_0). The cost of investing, in turn, is uniformly distributed on the range from zero to roughly 13.5.

The signal variance is approximately 8. Recalling that the signal for a good match has unit mean, after 32 periods (16 months) the sum of signals has mean 32 and standard deviation 16 ($\sqrt{32 \times 8}$). Thus, the probability of a high productivity match generating a negative sum of signals at that point is less than 2.5%. Finally, the calibrated probability of labor-market shock per period is of 0,97%, implying an expected wait of 4 years and three months between formal market job opportunities.

Parameter		Value
Base productivity	y_0	1
Increase due to investment	α	0.8081
Maximum investiment cost	$\bar{C}$	13.5180
Discount factor	δ	0.9935
UI replacement ratio	ρ	0.77
Worker's bargain power	γ	0.50
Signal variance	σ_s^2	7.9640
Technological shock rate	θ	0.0070
Labor market shock rate	λ	0.0097

Table 3.1: Calibrated parameters

In equilibrium, the probability of a worker investing is 56.6% and wages are 15% larger than the worker's opportunity cost. Expected employment duration is of three years and five months, and is approximately ten times higher for high productivity matches than for low productivity ones. This evidences an important role of learning on determining the actual productivity of formal matches, consistently with estimates in Chapter 2. These results are summarized in Table 3.2.

The second column of the table shows the effect of eliminating fake lay-offs. As expected, eliminating the possibility of fake lay-offs results in an increase of p_H and w. The magnitudes are small: slight increases of 3.4% in the share of high quality matches and of 0.7% in wages. These modest figures reflect a relatively small number of fake lay-offs when compared to the turnover generated by the firm optimal firing behavior (whose outcomes are unaffected by the simulated policy change). Average productivity increases even less than p_H, by only 0.5%. This happens because selection already mitigates the effect of bad matches.

A much greater effect is obtained with elimination of UI benefits, as shown in the third column. In this case, the share of investing workers increases by more than 30%. Mostly driven by the composition of match quality, job duration increases by 26%, to more than four years. Further, economy-wide productivity would raise by 4.1%. These results show that, given the UI eligibility rules observed during the considered period, a worker would have an much higher expected UI benefit by choosing $I = 0$.

Outcome		Estimated model	No fake lay-offs	No UI	UI after 1yr tenure	UI after 2yr tenure
Probability of investment	p_H	0.566	0.585	0.740	0.713	0.750
Wage	w	1.168	1.176	1.268	1.243	1.265
Expected duration (months)						
overall	E[D]	41.04	42.24	51.93	50.29	52.61
low productivity match	$E[D_L]$	6.99	7.05	7.50	7.46	7.60
high productivity match	$E[D_{H,H^*}]$	67.12	67.17	67.53	67.50	67.58
non-revealed, high prod	$E[D_H]$	29.63	29.65	29.81	29.79	29.83
Average productivity	y	1.352	1.359	1.407	1.400	1.410

Table 3.2: Outcomes of calibrated and simulated models

Finally, the last two columns of Table 3.2 show the effects of changing the eligibility rule. We note that an increase of minimum tenure required for one year would be sufficient to generate an effect similar to that of eliminating the benefit. Further, increasing the threshold to 2 years would an even large effect than moving to a "no UI" situation.

This illustrates the fact that a large enough UI eligibility threshold may provide stronger incentive to investment by the worker than the complete elimination of the benefit. This occurs because, with such a high threshold, the investing workers have a much larger probability to receive the benefits than the non-investing. It can be noted that the reward structure induced by this policy works effectively as a deferred payment scheme, such as discussed by (Lazear, 1981).

3.5
Conclusion

In this chapter we proposed a model relating the access to UI benefits to the incentives for the investment employment relationships. We focused on the impact of UI rules, which condition the benefit on involuntary separation, and on the possibility of collusion between employer and employee to label a separation initiated by the latter as a lay-off, in order to collect the associated benefits.

The simulation exercises have shown that fake lay-offs should have a modest impact on match productivity and duration. This result is related to the fact that, according with our calibration, most of the separations are involuntary. Elimination of UI, in turn, benefit generates substantial effects on productivity and job duration.

Finally, we find suggestive evidence that a large enough eligibility threshold for UI may turn the benefit into an incentive for the worker to invest in a relationship. In this case, it could provide a more favorable environment for investment in human capital than the complete elimination of the UI provision. This is reminiscent of the use of deferred payments as an incentive to effort by workers.

An important caveat about the results is that they rely on extrapolation from observed agents' behavior in a single institutional setting. Importantly, there is no source of variation allowing to make inference about the workers' investment costs distribution and thus the magnitudes of the large policy changes considered is only suggestive. The recent changes in the Brazilian UI program will provide an opportunity for further testing the model. Those changes increased the eligibility threshold for the first and the second request by any worker to, respectively, 18 and 12 months of tenure. Hopefully, this will allow a more precise assessment of the effects of UI on investment in human capital.

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